Evidence-based clinical guidelines

for the diagnosis, assessment and physiotherapy management of shoulder impingement syndrome

THE CHARTERED SOCIETY OF PHYSIOTHERAPY

Acknowledgements

The Guideline Development Group (Appendix 1) would like to thank the following for their assistance and support in developing these guidelines:

- Advisers to the guideline development group (Appendix 2)
- The local peer review group (Appendix 3)
- The national peer review group (Appendix 4)
- The Chartered Society of Physiotherapy
- Portsmouth City Teaching Primary Care Trust (PTC), Fareham and Gosport PCT & East Hants PCT
- The School of Health and Social Care, University of Teesside
- Teesside Centre for Rehabilitation Sciences, University of Teesside
- Clinical Audit Department, Portsmouth City Teaching PCT.

The Guideline Development Group are also grateful to Kate Davies, Charlotte Gray, Suzanne Harradine, Lisa Harvey, Catherine Pollitt, Sue Screaton and Belinda Trewby for their valued contributions.

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This clinical guideline was endorsed by the Chartered Society of Physiotherapy in July 2004.
The endorsement process has included review by relevant external experts as well as peer review.
The rigour of the appraisal process can assure users of the guideline that the recommendations for practice are based on a systematic process of identifying the best available evidence, at the time of endorsement.

Review date: 2008

Nigel Hanchard

Janis Cummins

Claire Jeffries

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Introduction

1.1 Why evidence-based clinical guidelines for shoulder impingement syndrome (SIS)?

Shoulder pain accounts for over 1% of general practitioner (GP) consultations (Green et al, 2003a) and in due course, according to a Dutch study, 30% of these patients are referred for physiotherapy (Liesdeck et al, 1997). 'Impingement' probably accounts for half of such referrals (Dinnes et al, 2003). These data hint at the problem impingement presents on a nationwide basis. This is an area where evidence-based practice might have a great impact, because evidence suggests that impingement does respond to appropriate physiotherapy (Green et al, 2003a).

Physiotherapists have a duty to base their practice on such evidence, that is to say, the best available (Department of Health, 1998, Chartered Society of Physiotherapy, 2000, 2002). But from the perspective of a busy clinician, evidence-based practice may prove an elusive standard: the body of evidence may appear so large, so variable in quality and so contradictory as to be overwhelming. Some form of overview is clearly required. This need is partly satisfied by a recent, major, systematic review of diagnostic studies (Dinnes et al, 2003), and Cochrane reviews (e.g., Buchbinder et al, 2003, Green et al, 2003a,b). However, many 'diagnostic' studies did not meet Dinnes et al's (2003) criteria for inclusion; and Cochrane reviews, on the whole, are restricted to randomised controlled trials (RCTs) of interventions, and do not incorporate research of other types.

Drawing on Cochrane reviews as the 'gold standard' of evidence on interventions, and Dinnes et al's (2003) systematic review as their diagnostic equivalent, the present guidelines integrate this information into one source, use transparent processes to 'plug the gaps' with evidence from weaker sources, and endeavour to provide plain, practical and well justified recommendations.

1.1.1 The clinical question

These guidelines address the clinical question:

- What is best practice in the physiotherapy diagnosis, assessment and management of shoulder impingement syndrome?

1.2 Target users

It is anticipated that these guidelines will be used by general practitioners, orthopaedic surgeons and rheumatologists, in addition to physiotherapists.

1.3 Aims

- To facilitate best practice in physiotherapists' diagnosis, assessment and management of shoulder impingement syndrome, and related professionals' awareness of such practice
- To standardise physiotherapists' diagnosis, assessment and management of shoulder impingement syndrome.

1.4 Objectives

- To identify and critically appraise the best available evidence relating to the assessment and diagnosis of shoulder impingement syndrome
- To identify and systematically appraise the best available evidence relating to the physiotherapy management of shoulder impingement syndrome
- To make recommendations, derived by transparent processes from the best available evidence, for the assessment and diagnosis of shoulder impingement syndrome
- To make graded recommendations, again derived by transparent processes from the best available evidence, for the physiotherapy management of shoulder impingement syndrome
- To highlight areas where further research is required.

1.5 Scope of the guidelines

These guidelines are intended to apply to shoulder impingement syndrome in adults aged 18 and over, irrespective of their gender or race. They may be utilised to inform all stages of the non-operative or pre-operative care pathway, namely:

- Initial assessment/diagnosis
- Physiotherapy management
- Evaluation of outcome
- Patient discharge to self-management
- Referral for orthopaedic opinion (if required)

They specifically do not apply to:

- Pain from causes other than shoulder impingement syndrome
- Impingement in the hemiplegic shoulder
- Alternative therapies (for this purpose, acupuncture is considered an alternative therapy)
- Peri- or post-operative management.

1.6 Development strategy

1.6.1 Guideline Development Group (GDG)

The guidelines were developed by a core group of clinical and academic physiotherapists, each with a special interest in the shoulder (Appendix 1).

Conflict of interest: Nigel Hanchard is a Fellow and senior lecturer of the Cyriax Organisation. No other potential conflicts of interest were declared.

1.6.2 Advisers to the GDG

The GDG was supported by a number of advisers drawn from among senior academic and clinical physiotherapists (Appendix 2).

1.6.3 Peer review

Prior to CSP endorsement, the guidelines underwent a two-stage quality assurance process, comprising a 'local' and then a national review. Reviewers were briefed to critically comment on:

- The overall development strategy
- The validity of the recommendations
- The clinical relevance of the guidelines and recommendations
- The format, layout and presentation of the document.

1.6.3.1 Stage one: 'local' peer review

Peers and medical colleagues local to the Portsmouth area reviewed the guidelines during their development (Appendix 3) and offered suggestions for improvements. Rotational physiotherapists (staff grade and senior II) in musculoskeletal outpatients also contributed to this process, as did final year physiotherapy students at the University of Teesside, Middlesbrough.

1.6.3.2 Stage two: national peer review

Approaches to diagnosing, assessing and managing shoulder impingement syndrome are diverse, and the GDG was keen to expose the developing guidelines to a range of perspectives in order that they should be as representative as possible. With this in mind, review was invited from selected leading academics and clinicians chosen to embody a representative breadth of opinion in the field at a national level (Appendix 4).

Reviewers' comments and the GDG's responses are tabulated in Appendix 5.

1.6.4 Service users' focus group

Service users' views were obtained, regarding the acceptability of the recommendations from their personal perspectives, in a focus group (Appendix 6).

1.6.5 Funding

The respective employers of the GDG released the members for meetings and met associated travel and subsistence costs. The Chartered Society of Physiotherapy (CSP) provided meeting rooms without charge and funded the production of the final document. No other specific internal or external funding was provided.

1.7 Searching for the evidence

AMED, CINAHL, EMBASE, MEDLINE, PEDro and PreMEDLINE were searched 1982 to March 2002 for the following key words:

- Shoulder/s
- Injuries/pathology
- Rotator cuff injuries
- Tendinitis
- Glenohumeral joint
- Impingement syndrome
- Shoulder impingement syndrome
- Subacromial impingement syndrome

- Rehabilitation
- Instability
- Exercise rehabilitation
- Physical therapy
- Conservative treatment
- Shoulder surgery
- Sports rehabilitation.

The detailed electronic search strategy is shown in Appendix 7. In addition, members of the GDG conducted hand searches for relevant material in textbooks and journals not included in the databases, and all literature obtained was scanned for further references. Searches were limited to human studies. Where these were lacking, the search was extended to include animal studies. For practical reasons, searches were limited to the English language. Further searches were made up to October 2003 for new systematic reviews which the GDG considered important to the guidelines.

1.7.1 Literature appraisal process

Members of the GDG, the advisers to the GDG and clinical colleagues undertook the literature appraisal process after training.

1.7.1.1 Evidence relating to physiotherapy interventions

The GDG graded evidence relating to physiotherapy interventions, including injection therapy, according to CSP recommendations (CSP, 2003) as set out in Table 1.1.

Table 1.1 Levels of evidence (CSP, 2003)

Level	Type of evidence
Ia	Evidence obtained from a systematic review or randomised controlled trials
Ib	Evidence obtained from at least one randomised controlled trial
IIa	Evidence obtained from at least one well-designed controlled study without randomisation
IIb	Evidence obtained from at least one other type of well-designed quasi-experimental study
III	Evidence obtained from well-designed non-experimental descriptive studies, such as comparative studies, correlation studies and case studies
IV	Evidence obtained from expert committee reports or opinions and/or clinical experience of respected authorities

Eight relevant systematic reviews were identified, all of which were utilised in the present guidelines. These were *Interventions for shoulder pain* (Green et al 2003a); *Corticosteroid injections for shoulder pain* (Buchbinder et al 2003); *Physiotherapy interventions for shoulder pain* (Green et al, 2003b); and *Deep transverse friction massage for treating tendinitis* (Brosseau et al 2003). These four are all Cochrane reviews which, where appropriate, subject existing data to meta-analysis, and which may be considered a 'gold standard' of Grade 1a evidence. *BMJ Clinical Evidence* (Speed and Hazleman 2003) was also consulted, as were the *Philadelphia Panel evidence-based clinical practice guidelines on selected rehabilitation interventions for shoulder pain*, which derived evidence from systematic reviews and meta-analyses using Cochrane methodology, but expanded the search strategy to include case-control, cohort and non-randomised studies, Albright et al (2001), and van der Heijden et al's (1997) publication, *Physiotherapy for patients with soft tissue shoulder disorders: a systematic review of randomised clinical trials*. Finally, Towheed et al (2003) was consulted in relation to the risks and benefits of non-steroidal anti-inflammatory medication.

The GDG appraised original research articles using a system based on Guyatt et al (1993). The system is shown in Appendix 8, and the individual appraisals are tabulated in Appendix 9. To avoid duplication, trials included in existing Cochrane reviews were not routinely re-appraised. However, such re-appraisal was conducted where it was deemed, by consensus, that this would enhance the guidelines' value.

Level IV evidence was obtained from published consensus statements and guidelines, standard textbooks and course material. The GDG decided not to use a survey due to the absence of a mechanism for weighting organisations' and individuals' contributions. It was felt that contradictory views and bias might occur.

The GDG then formulated recommendations, graded according to the level of the evidence (Table 1.2).

Table 1.2. Grading of recommendations (after NICE, 2001)

Grade	Evidence
A	At least one randomised controlled trial as part of a body of literature of overall good quality and consistency addressing the specific recommendation (evidence levels Ia and Ib in Table 1.1)
B	Well-conducted clinical studies but no randomised clinical trials on the topic of the recommendation (evidence levels IIa, IIb and III in Table 1.1)
C	Expert committee reports or opinions and/or clinical experience of respected authorities (evidence level IV in Table 1.1). This grading indicates that directly applicable studies of good quality are absent.
	Good practice point (GPP) Recommended good practice based on the clinical experience of the Guideline Development Group

1.7.1.2 Evidence relating to diagnosis and assessment

The GDG identified one relevant systematic review relating to diagnosis and assessment (Dinnes et al, 2003). It undertook critical narrative evaluation of articles by Dinnes et al (2003) which were worthy of special consideration. Relevant articles which were outside Dinnes et al's scope but important to these guidelines were also narratively evaluated.

Such articles were evaluated by at least two of the GDG, who reached a consensus about the grading of the article through discussion. However, criteria for appraising articles on treatment interventions (e.g., Guyatt et al, 1993), and grading evidence and recommendations based upon them (e.g., CSP, 2003), are not transferable to articles on diagnosis and assessment (Irwig & Glasziou, 1996, Deeks, 2001). Consequently, individual diagnosis- and assessment-related articles were not included in the table of appraisals (Appendix 9); nor were "levels of evidence" or "grades of recommendations" specified for the diagnostic/assessment literature. We anticipate that future editions of these guidelines will include systematic reviews of the assessment literature in line with a Cochrane protocol now under development (http://www.cochrane.org/cochrane/sadtdoc1.htm).

1.8 Dissemination

The GDG recommends that copies of the guidelines be distributed by the CSP through:

- Physiotherapy managers
- Physiotherapy educators
- Relevant professional bodies and special interest groups
- Other relevant national and international bodies
- The CSP's web-site.

We also recommend that the guidelines be presented at training workshops, CSP congress and other appropriate national and international conferences.

1.9 Implementation

Evidence-based standardisation of diagnosis, assessment and management of shoulder impingement syndrome will potentially benefit physiotherapy students; any physiotherapy practitioners who manage this disorder, in any setting, or who may be involved in its prevention; the NHS and other health care providers; and, ultimately, patients. The guideline will be useful for future research purposes.

The GDG has presented recommendations, based on stringent appraisal of the available evidence, in the hope that they will facilitate these ends. However, like all interpretations of evidence, it is necessarily subjective. It is not the intention to impose recommendations on colleagues or to compromise their individual autonomy as consumers of research. Nor are the guidelines intended to present an alternative to reflective practice or an obstacle to innovative practice.

1.10 Revisions

The guidelines will be periodically re-evaluated by the GDG, and revised should it be felt that substantive developments have occurred. It is anticipated that the next full revision will be in 2008.

1.11 Health benefits, side effects and risks

Where there is evidence of specific interventions or omissions being associated with health benefits, side effects or risks, this is stated in the relevant section(s) of the guidelines.

1.12 Barriers to implementation

To ensure the successful implementation of these guidelines the following questions should be considered:

- Are all relevant physiotherapy staff aware of the contents of the clinical guidelines, and do they have access to adequate training as appropriate?
- Is there an appropriate referral system in place allowing patients access to physiotherapy services i.e. are there:
  (i) Established referral pathways across clinical areas?
  (ii) Appropriate forms on which GPs and consultants may refer patients with shoulder pain?
- Are there referral pathways in place for steroid injection to be considered?
- Where conservative management has proved ineffective, are systems in place allowing referral of patients on for orthopaedic opinion?
- Will physiotherapists be prepared to modify their clinical practice in light of the guidelines' recommendations?

1.13 Cost implications

Consideration may need to be given to the cost implications when implementing these guidelines. These include:

- Staff training
- Equipment requirements e.g., ice machine, sling suspension, resistance bands, ultrasound machine, free weights
- The duration of treatment sessions
- The number of patient treatment sessions required.

1.14 Audit

A suitable audit tool to evaluate the implementation of the guidelines will be developed by the GDG and the CSP.

1.15 References supporting Section 1

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2

Shoulder impingement syndrome

2.1 Definition of shoulder impingement syndrome

During elevation of the shoulder, the humeral tuberosities pass close under the coracoacromial arch. Little clearance is left for the intervening soft tissues, which comprise (from superficial to deep), the bursa variously known as 'subacromial' or 'subdeltoid', the rotator cuff tendons, and the long head of biceps. If, for any reason, the available space reduces, these soft tissue structures are liable to become pinched. This is called 'shoulder impingement syndrome' (SIS); or alternatively 'subacromial impingement syndrome', 'painful arc syndrome' or 'clinical impingement syndrome'.

Posterior superior glenoid impingement (PSGI), and superior labrum anterior to posterior (SLAP) lesions (which may also cause impingement) are considered as distinct entities, as defined below (Section 2.2)

2.1.1 Underlying mechanisms

A number of possible mechanisms underlie SIS, some well documented, others more speculative:

- Bony anatomical and pathological factors*

  These include the type III (hook-shaped) acromion process which, in cadaveric studies, has been found to correspond with a high likelihood of rotator cuff tears. Other bony factors, implicated by clinical evidence, are os acromiale (a mobile, unfused, anterior acromial epiphysis, which may tilt inferiorly) and osteophytes projecting from the acromioclavicular joint or acromion.

- Shoulder instability*

  Rotator cuff weakness
  The importance of the rotator cuff in the active stabilisation of the shoulder joint is uncontroversial. Impingement has been produced in cadavers by simulated 'muscle imbalance' (Payne et al, 1997). A radiographic study of normal subjects has shown that the humeral head migrates proximally when the cuff is fatigued.

  Capsulo-ligamentous laxity
  Capsulo-ligamentous laxity, and consequent minor subluxation of the glenohumeral joint, is widely believed to underlie impingement in the younger population, especially in athletes (such as throwers and swimmers).

- Impaired scapulohumeral rhythm and scapular instability

  Normally, concurrent movement of humerus and acromion during shoulder elevation prevents impingement. If scapular motion were impaired, impingement might be expected; and in fact, relative to normal controls, scapular motion during elevation is impaired in people with shoulder impingement. This is linked to decreased serratus anterior activity and scapular instability (such that the scapula tends to medially rotate when the shoulder is elevated against a load), emphasising the importance of the scapula-controlling muscles in this connection (Ludewig and Cook, 2000).

- Capsular tightness

  A correlation has been shown between impingement and posterior capsular tightness, although it is unclear which is cause, and which effect (Tyler et al, 2000).

- Postural factors

  The potential for a link between posture and impingement may be illustrated by elevating the arm in a coronal plane while slouching. It causes a painful arc, presumably by depressing the point of the acromion and lowering the acromial arch.

- Soft tissue changes*

  Inflammation and thickening of the subacromial bursa or rotator cuff, for example due to overuse, may result in narrowing of the subacromial space, as may calcific thickening of the supraspinatus tendon. Partial rotator cuff tears, secondary to degenerative tendinopathy, allow the humeral head to migrate proximally.

  These mechanisms may not be – and probably seldom are – mutually exclusive. An initially simple, isolated impingement problem may initiate a cascade of events that interact in complex ways, each reinforcing the other, to hinder resolution. Painful partial-thickness tears of the rotator cuff, for example, inhibit muscle function (Itoi et al, 1997); consequent muscle 'imbalance' increases impingement; and increased impingement may aggravate partial tears and worsen pain.

  A vicious cycle becomes established, and the eventual tendency is towards erosion of the rotator cuff. Neer and Welsh (1977) classified this process into a three-stage continuum, with reference to the appearances of the supraspinatus tendon (the most commonly involved component of the rotator cuff) and the structure overlying it, the subacromial bursa. Their classification is much cited in the literature.

* For an extensive review the reader is referred to Bigliani and Levine (1997)

2.1.2 Neer and Welsh's (1977) classification

Stage I Reversible subacromial oedema and haemorrhage, usually in the under-25 age group, as a result of overuse.

Stage II Fibrosis and tendinitis, usually in the 25–40 age group, following repeated episodes of mechanical inflammation and irreversible by conservative treatment.

Stage III Bony changes and cuff tears, usually in the over 40 age group.

Three important points should be appended to this classification.

- First, as discussed by Zuckerman et al (1991), the onset of stage I is not rigidly restricted to the under 25 group, but could occur at any age, given the right conditions (in particular an excess of overhead activity).
- Second, when problems do occur in the under 25s, underlying instability should be specifically considered. Indeed, in Parker and Seitz's (1994) consecutive series of 50 patients with 'shoulder impingement/instability overlap syndrome', ages ranged up to 38 years (mean 26 years).
- Third, recent work has shown that stage II impingement IS responsive to appropriate conservative treatment; and it is by no means certain that partial thickness cuff tears (components of stage III impingement) are not (Brox et al, 1999).

2.2 Other types of impingement at the shoulder

Two other types of impingement are recognised, whose mechanisms differ sufficiently from those described above to warrant separate nomenclature:

Posterior superior glenoid impingement (PSGI)
This commonly results from repetitive microtraumas sustained in the 'throwing' position (extension, abduction and external rotation). It may cause secondary joint-side cuff tears (possibly inducing SIS, as described above) or labral damage (as described below). The extent to which instability underlies this condition is unclear (Jobe, 1995, Cavallo and Speer, 1998).

Superior labrum anterior to posterior (SLAP) lesions

The incidence of SLAP lesions is not known. A number of large studies have reported them in around 6% of arthroscopies for shoulder pain (e.g., Snyder et al, 1990, Handelberg et al, 1998). But, by definition, these studies relate to a selected sub-group of patients, and in the shoulder pain population at large SLAP lesions may be less common. SLAP lesions may result from trauma or degeneration, but are more typically associated with throwing. Biceps helps decelerate the arm at the end of the cocking phase, and large traction forces develop at its attachment to the superior part of the glenoid labrum. As a result, the labrum may peel off the underlying bone: hence the term, 'superior labrum anterior to posterior (SLAP) lesion'. Varying degrees of severity have been described (Snyder et al, 1990), and although the mechanism of injury may be tractive, features of impingement often result (Stetson et al, 1997).

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Evidence underpinning the diagnosis and assessment of shoulder impingement syndrome

3.1 Subjective assessment

3.1.1 Age

- SIS spans the age ranges occupied by other shoulder conditions. However, if it is present, the patient's age may give some indication of its likely stage (see section 2.1.2).
- PSGI tends to be seen in the under 35s, according to Cavallo and Speer (1998), but in Jobe's (1995) series of eleven patients with this condition, the age was somewhat higher (mean 36 years, range 20-55, standard deviation 11). The discrepancy may relate to differences in patient populations (see section 3.1.2).
- Symptomatic SLAP lesions have similar mechanisms, and a similar age distribution to PSGI, with a mean of 34 years reported by Liu et al (1996). SLAP lesions are seen in 20% of cadaveric shoulders (Haury et al, 1999), but may be of a 'silent' degenerative type, asymptomatic in life.
- Adhesive capsulitis is said to typically affect the 40–60 age group (Neviaser and Neviaser, 1987).

3.1.2 Mode of onset

- SIS's mode of onset varies. It may be insidious or related to a specific incident.
- PSGI, though commonly seen in sportsmen, and especially throwers (Cavallo and Speer, 1998), is by no means limited to these groups. In Jobe's (1995) series of eleven patients who were able to describe their injuries, six were not sportsmen although their injury mechanisms were similar to throwers'. One, a forklift driver, habitually horizontally extended his arm, resting it on his seat, to look over his shoulder while reversing (Jobe, 1995).
- In Liu et al's (1996) series of 41 patients with SLAP lesions, 64% were throwing athletes and most (61%) recalled a traumatic event.
- Acromioclavicular joint (ACJ) osteoarthritis is usually a late sequel to injury (American Academy of Orthopaedic Surgeons, 2001).

3.1.3 Pain

The pain of SIS, felt in the shoulder region or radiating into the arm, has been characterised as sharp and catching or a chronic ache after use, and is likely to be aggravated by overhead work. Placing the hand behind the back may also hurt. Classically, there is a painful arc on elevating or lowering the arm, or both, as the humeral tuberosities pass under the coraco-acromial arch: hence the synonym, 'painful arc syndrome'. Night pain, which may be severe enough to prevent lying on the affected side, is another commonly described feature, and is particularly associated with rotator cuff tears (e.g., Zuckerman et al, 1991). Clinical experience shows that night pain is a common feature of adhesive capsulitis, too, so caution should be exercised in attributing it to SIS; but an appropriate combination of age and night pain is suggestive. In this connection, Litaker et al (2000) showed arthrographically-determined cuff tears to be significantly ($p < 0.05$) correlated with three factors: age (> 65 years), night pain and weak external rotation. These correlates were respectively allocated weightings of two, one and two, and a tally of four or more was found to be the best predictor of abnormality.

Symptoms arising from the ACJ are likely to be accurately localised to the joint. Osteoarthritis here produces aching after activity: night pain does not occur, although in advanced arthritis, rolling onto the affected side may painfully compress the joint.

Night pain can accompany SIS secondary to instability or PSGI, but it is less severe than that seen in

cuff tears or adhesive capsulitis. The pain is also more predictably activity-specific and, in the case of PSGI, may be felt posteriorly (reviewed by Cavallo and Speer, 1998). Unfortunately there is little predictable about symptoms arising from SLAP lesions, which, judging from large, retrospective analyses, may mimic SIS (Stetson et al, 1997) and have been termed 'vague and inconsistent' (Handelberg et al, 1998).

3.1.3.1 Quantifying pain

Quantifying pain enables interventions' effectiveness to be judged over time. For this purpose the visual analogue scale (VAS) and numeric pain rating scale (NPRS) are most often used. Both have been validated for orthopaedic and rheumatological use. The VAS comprises a continuum between the extremes of "no pain" and "pain as bad as it could be", represented by an ungraduated 100 mm line on paper. Patients mark their pain level on the line, and the score (the distance from "no pain" to the patient's mark) is then measured by the clinician, in millimetres, using a ruler. Scores above 30 mm correspond to "moderate" pain or worse, and above 54 mm to "severe" pain or worse. Test-retest reliability is high.

The NPRS requires patients to represent their pain intensity over the previous 24 hours by circling a number on a 0-10 scale. Alternatively, patients may verbally report their pain scores. Test-retest reliability is high, as is correlation with the VAS, and the NPRS is quicker and easier to administer, as well as being more manageable for older people and people who do not find reading easy. However both VAS and NPRS are less sensitive to change than might be imagined. To be confident of change (smallest detectable difference) a variation of ± 28 mm is required for the VAS, and ± 3 points for the NPRS. This may present practical difficulties, because these values represent such large proportions of their respective scales (Finch et al, 2002).

3.1.4 Other symptoms

Symptoms suggestive of underlying instability may come to light during the subjective assessment. These can include a sense of instability, apprehension of dislocation on overhead movements, 'dead arm syndrome' (which can accompany anterior subluxation or provocative movements in multi-directional instability), subjective heaviness of the arm, or painful clicking (Magarey and Jones, 1992, Parker and Seitz, 1997, Mahaffey and Smith, 1999). Painful clicking may also accompany SLAP lesions (Liu et al, 1996). Crepitus has been associated with partial cuff tears (Fukuda et al, 1996).

3.1.5 Function

Functional status indices provide invaluable outcome measures. Self-assessment questionnaires have the added advantages of emphasising the patient's involvement in the process and enabling postal follow-up. Validated measures of this type include, among others, the DASH (Disabilities of the Arm, Shoulder and Hand) questionnaire, which takes approximately five minutes to complete and is freely available from:

Institute for Work & Health
481 University Avenue, Suite 800
Toronto, ON M5G 2E9
FAX: 416-927-4167
Email: DASH@iwh.on.ca
URL: http://www.iwh.on.ca

Information on more shoulder indices, and general guidance, is available from the expanding CSP outcome measures database at:
http://www.csp.org.uk/effectivepractice/outcomemeasures/onlinedatabase.cfm

3.2 Objective assessment

3.2.1 Inspection

3.2.1.1 Muscle bulk

In chronic SIS, atrophy of the spinati may be marked: Miniaci and Salonen (1997) have clearly illustrated this photographically. Atrophy also accompanies cuff rupture and neurogenic disorders.

3.2.1.2 Cervical and upper thoracic posture

Posture has been implicated in SIS, and some evidence seems to support this. Greenfield et al (1995) evaluated 30 asymptomatic subjects and 30 patients with unilateral or bilateral shoulder pain, and reported a systematic tendency towards 'forward head posture' ($p < 0.001$), but no difference in mid-thoracic posture, in the latter. The results of this careful study, which used complex but demonstrably reliable measurement methods, validated against x-ray findings, therefore suggest that 'forward head posture' may be relevant to SIS, though – due to the heterogeneity of the patient group – this cannot be stated with certainty. In addition, Crawford and Jull (1993) have shown an inverse relationship between thoracic kyphosis and the range of arm elevation in 30 asymptomatic women aged from 50–75 years, and it seems reasonable to suppose that in those with decreased range there is increased potential for impingement.

3.2.1.3 Static scapular posture

Muscle imbalance theorists have speculated on a train of events where protracted posture stretches and weakens the scapular elevators and retractors, disturbing scapulohumeral rhythm, and predisposing to pain (Kendall & McCreary, 1983). Whether or not this is true, it seems plausible that resting scapular postures involving abnormal depression of the acromion might contribute to SIS (discussed by Bøhmer et al, 1998), so a theoretical argument may be made for evaluating scapular posture.

In practice this is easier said than done. Scapular posture is three-dimensional and complex, and to characterise it fully the observer must take account of rotation about an antero-posterior axis ('upward/downward rotation' or 'abduction/adduction'); rotation about a vertical axis (with the vertebral border becoming prominent in 'medial rotation' or 'winging', and the reverse in 'lateral rotation'); and rotation about a transverse axis ('anterior/posterior tilt'). In addition, upward and downward translations ('elevation' and 'depression') may occur, as may translatory movements towards or away from the vertebral column (confusingly referred to as 'adduction' and 'abduction' by some workers e.g., DiVeta et al, 1990). 'Protraction' (or 'forward shoulder posture') combines translation away from the vertebral column with medial rotation, while the lateral clavicle moves forwards; retraction is the reverse of this (Culham and Peat, 1993, Neiers and Worrell, 1993, Ludewig and Cook, 2000).

Capturing, recording, and interpreting so much information is problematic in the laboratory, let alone the clinic, where tools for measuring 3-D spacial relationships are not available. Even so, some attempts have been made to develop simple, practical ways for clinicians to measure protraction. DiVeta et al (1990) devised an approach using string to measure from the acromial angle to the T3 spine, 'normalising' the value obtained (i.e. dividing it by scapula length) to account for individuals' differences in size. These workers reported fair reliability within-testers for their technique, with Intradass Correlation Coefficient (ICC) of 0.78 for normalised values (Neiers and Worrell, 1993). Subsequent large studies have failed to reproduce acceptable reliability for normalised values, but have reported good to high within-tester reliability for raw measurements of protraction, such that true values would be expected to fall within ± 1-2 cms of measured values 95% of the time (Neiers and Worrell, 1993, Gibson et al, 1995). Gibson et al (1995) also evaluated between-tester reliability, and reported a high value.

An alternative method of evaluating protraction, the 'lateral slide test', involves tape-measuring from the inferomedial angle of the scapula to the nearest spinous process in three positions: arms at sides; hands on hips; and arms at or below 90° abduction, with humeral medial rotation (Kibler, 1998). Asymmetry greater than 1.5 cm in any of the positions is held to be the 'threshold of abnormality' (Kibler, 1998). The theoretical appeal of the lateral slide test is its potential to characterise scapular posture in three positions, but a number of well-designed studies have cast doubt on its reliability both within- and between-testers (Gibson et al, 1995, Odom et al, 2001).

Over and above these questions of reliability is one of validity. The terms 'normal' and 'abnormal' are not very meaningful in the context of static scapular posture, because normative work on large, heterogeneous samples is lacking; and such literature as there is does not support the theoretical link between static scapular posture and SIS. In fact, this literature suggests a high incidence of bilateral asymmetry in asymptomatic subjects (Sobush et al, 1996). Greenfield et al (1995) have shown that a mixed diagnosis shoulder pain group have no more tendency to this than asymptomatic controls. These findings cast doubt on the relevance of bilateral comparisons in clinical evaluation and, more fundamentally, the postulated relationship between static scapular posture and SIS.

In this connection, research has failed to support Kendall and McCreary's (1983) theorised stretch-weakening of the scapular elevator and retractor muscles by protracted posture. Indeed, this mechanism is specifically challenged by DiVeta et al (1990), who found only very weak correlations between the degree of postural protraction and the force of elevation ($r = 0.20$) and retraction ($r = 0.14$). Furthermore, Wang et al (1999) have shown in asymptomatic subjects that the degree of scapular protraction at rest (as determined by a validated 3-D electromechanical digitiser) is uninfluenced by strengthening the scapular elevator and retractor muscles.

Evidence summary

- Available evidence does not support the concept of a relationship between static scapular posture and SIS.

For explanation of absence of level of evidence, see paragraph 1.7.1.2

3.2.1.4 Scapulohumeral rhythm

Normal scapulohumeral rhythm is smoothly synchronous, and gross aberrations may be obvious clinically. Even so, objective characterisation of the scapulohumeral relationship during elevation has proved especially difficult, precisely because of its dynamic nature. Typically, researchers have tried to circumvent this problem by assessing the bones' relationships in a series of static postures (e.g., Doody et al, 1970, Bagg and Forrest, 1988), but it is unclear whether these postures apply to dynamic function.

In recent years, a number of studies have dynamically evaluated scaption (shoulder elevation in the plane of the scapula see also Fig 7.11). Michiels and Grevenstein (1995) assessed 38 normal subjects using rapid x-ray sequences; Ludewig and Cook (2000) 26 asymptomatic subjects by means of electromagnetic sensors; and McClure et al (2001) three volunteers by reference to pins inserted into their scapulae. Although precise scapulohumeral rhythm appears to be unique to individuals (Michiels and Grevenstein, 1995, Ludewig and Cook, 2000, McClure et al, 2001), some general tendencies have been observed. Based on two of the three studies (Michiels and Grevenstein, 1995 and McClure et al, 2001) it appears that scapular upward rotation is more or less linear through range, especially beyond 50°, irrespective of speed or loading; and Michiels and Grevenstein's (1995) statistical analysis did not support the concept of scaption being divisible into distinct phases of scapular rotation. (Ludewig and Cook, 2000 – while acknowledging marked variation in 'normal' scapulohumeral rythm – reported a greater rotatory component, in general, between 90° and 100°, but their subjects, who were habituated to overhead work, were not necessarily representative of a 'typical' population). Scapular external rotation and posterior tilting are non-linear, however, occurring beyond 90°, and these movements are large, with mean values for posterior tilt and external rotation of 30° and 24° respectively, according to McClure et al (2001). In total, scapular motion contributes roughly one-third of scaption range (Michiels and Grevenstein, 1995, McClure et al, 2001).

Ludewig and Cook (2000) also evaluated 26 symptomatic SIS patients, reporting reduced scapular rotation towards 60°, more so with loading, and increased anterior tilt as scaption approached 120°. Considering the possibility of impingement under the anterior acromion, these observations might be very pertinent. Concurrent EMG analysis of upper and lower trapezius and serratus anterior indicated reduced activity in the latter muscle, implicating it in the abnormal movement pattern.

Evidence summary

- SIS patients demonstrate reduced scapular rotation in mid range scaption, more so with loading, and increased anterior tilt in the last third of range.

For explanation of absence of level of evidence, see paragraph 1.7.1.2

3.2.2. Physical tests

3.2.2.1 Range of movement

The principal differentiations to make are between SIS, SIS secondary to instability, other (intracapsular) causes of impingement, ACJ arthritis, and adhesive capsulitis, none of which is necessarily mutually exclusive.

There is consensus that adhesive capsulitis is associated with potentially gross limitation of passive movement, most notably external rotation (e.g., Bunker, 1997); likewise that ACJ pain is best replicated by horizontal adduction (Miniaci and Salonen, 1997). Pain on horizontal adduction is not unique to the ACJ, though. In Calis et al's (2000) study, 82% of patients with SIS, verified by subacromial local anaesthesia, demonstrated this sign.

Some authorities have associated SIS with full passive range by definition (e.g., Cyriax, 1982). But most envisage a mechanism whereby pain or weakness may limit active range of elevation, horizontal adduction, and internal rotation, leading to adaptive shortening and mild passive limitation(s) of movement. Conversely, limitations of passive range, from whatever cause, might precipitate or perpetuate impingement. In a cadaveric study, Harryman and co-workers (1990) found that tightening the posterior part of the capsule caused significant superior translation of the humerus during shoulder flexion, a mechanism that has been likened to a yo-yo rolling up a string (Matsen and Arntz, 1990). There is also evidence of an association between impingement and posterior capsular tightness from a study of patients and normal controls by Tyler et al (2000), in which capsular tightness was determined by passive horizontal adduction and internal rotation.

Although range of movement at the shoulder is commonly evaluated by visual estimation or universal goniometry, few studies have evaluated these methods' reliability in symptomatic subjects. In one, by Riddle et al (1987), 16 randomly-paired physiotherapists measured passive shoulder ranges in two groups of 50 patients, using goniometers of 2 different sizes. Reliability within-testers (i.e. the consistency of the same testers' measurements over time) was 'excellent' irrespective of the movement measured or the size of goniometer used (ICCs 0.87–0.99). Between-testers, however, reliability was movement specific, being 'excellent' for composite glenohumeral flexion and abduction, and external rotation in abduction (ICCs 0.84–0.90), but ranging from 'poor' to 'fair' for horizontal abduction and adduction, composite glenohumeral extension, and internal rotation in abduction (ICCs 0.26–0.55). The latter low values reflect this pragmatic study's deliberate non-standardisation of patient positioning and measurement technique, and clearly underline the need for standardisation in clinical practice. More recently, Hayes et al (2001) investigated the reliability of goniometry of active movements, and visual estimation of passive movements, as applied by two physiotherapists, an orthopaedic surgeon and a trainee sports physician to eight symptomatic shoulders. Goniometry and visual estimation were comparably reliable, falling in the 'fair to good' range both within-testers (ICCs 0.53–0.65 and 0.59–0.60 respectively) and between-testers (ICCs 0.64–0.69 and 0.57–0.70). But the standard errors associated with these measurements were large (14°–25° between-testers for goniometry; 14°–19° for visual estimation), meaning that, in the clinical setting, only gross changes could be confidently attributed to change in the patient's condition, as opposed to random variability.

With respect to goniometry, discrepancies between studies' results may relate to a number of factors, not least whether the movement being tested was passive or active. In clinical practice there is case for measuring both types of movement (with passive allowing specific evaluation of tissues' responses to stretch, and active having more functional implications) and the message is that the type of movement being measured must be specified to avoid ambiguity. Standardisation of patient positioning and measurement technique is evidently an important issue, and the reader is recommended to consult a standard text or the excellent goniometry web-site at http://academic.uofs.edu/faculty/kosmahle1/courses/pt350/goniomet/shabd.htm.

Inclinometers have also been used to evaluate range of movement at the shoulder. An inclinometer resembles a clock on a flat, rectangular base. The long axis of the base is applied along the line of the limb's moving segment, whose excursion is then registered on the 'clock face', in degrees, by a gravity-operated needle. A major advantage of these devices over universal goniometers is that they can be used one-handed, leaving the operator's other hand free to stabilise, or to guide or assist movement. They also enable acceptable reliability between-testers for most shoulder movements. Green et al (1998), who investigated this approach on a small but diverse patient sample using the Plurimeter-V inclinometer reported 'excellent' results for active composite scapular and glenohumeral flexion and abduction (ICCs 0.72 and 0.77 respectively) with the patient in standing; and for external rotation (ICC 0.88), with the patient lying, elbow-at-side and flexed to a right angle. These values compare favourably with those for goniometric measurement of active shoulder movements. However, only 'fair to good' between-tester reliability was reported for glenohumeral flexion (ICC 0.58) and glenohumeral abduction (ICC 0.59), and the value for medial rotation (ICC 0.44) was disappointing. Both Green et al (1998) and Hayes et al (2001) additionally evaluated an alternative, functional measure of 'internal rotation', the 'thumb up back' test, in which the highest vertebral level the patient can reach with his or her thumb is recorded. (While non-specific to the shoulder, this movement is one of obvious functional importance, especially for women). The large discrepancy in the between-tester reliabilities reported by these workers (ICCs 0.75 v. 0.26 respectively) probably reflects higher-level manual skills among Green et al's (1998) testers, all of whom were manipulative physiotherapists.

Tyler et al (2000) described a method for measuring horizontal adduction with the patient in side-lying, which appears to be both reliable and valid. One tester, ensuring the patient is neither tilted forwards or backwards, flexes, retracts and passively stabilises the uppermost scapula. The shoulder is passively abducted to 90°, then gently lowered into horizontal flexion until the patient perceives stretch, or the forearm deviates from the perpendicular, indicating the onset of capsular tension. A second tester measures the distance between the patient's medial epicondyle and the couch, using a large carpenter's square. Requiring two testers, this procedure is somewhat impractical, and clinicians might consider substituting an inclinometer for the carpenter's square. This adaptation would enable measurement by a single tester, but the reliability of such an approach has yet to be investigated.

Evidence summary

- Active & passive ranges should be measured.
- No method of measurement is entirely reliable and valid.
- For passive ranges, the universal goniometer gives excellent all round reliability within-testers, but its reliability between-testers is movement-specific.
- Universal goniometry of active ranges and visual estimation of passive ranges are both associated with large measurement error.
- The inclinometer's between-tester reliability for active ranges is movement-specific. Because the inclinometer leaves one of the operator's hands free, it might prove technically useful when measuring passive ranges, but it has not been evaluated in this context.
- Evaluating medial rotation is especially problematic. The 'thumb up back' test may be used, but its reliability depends on surface marking.
- Attention should be paid to standardising & recording the technique used, and to recording the type of range being measured (i.e. passive or active).

For explanation of absence of level of evidence, see paragraph 1.7.1.2

3.2.2.2 Instability

Instability may be of three types:

- Anterior instability, which may result from repeated microtrauma to the anterior capsule of the shoulder
- Multi-directional instability, which is associated with generalised musculoskeletal laxity (Parker and Seitz, 1997)
- Posterior instability which, as an isolated finding, is seldom encountered

There are a number of tests for these problems.

Load and shift manoeuvre

The patient sits, hand-on-thigh, the tester stabilising the clavicle and scapula with one hand, and cupping the head of humerus with the other. The tester gently compresses the humeral head medially to 'load' it into the glenoid, and maintains this loading while moving it anteriorly and then posteriorly. Magee (1997) defines the anterior load and shift test as positive if translation equates to > 25% of the humeral head's diameter, such that it can be felt riding over the edge of the glenoid. On the posterior load and shift test, translation of up to 50% of the humeral head's diameter is considered normal. In multi-directional instability, the test is positive in both directions.

Anterior apprehension test

The load and shift manoeuvre may not enable detection of very subtle instability, and where this is a possibility some authorities prefer the anterior apprehension test and the supplementary relocation test (see below). The tester passively moves the supine patient's shoulder towards 90° abduction and full lateral rotation, slowly and carefully. Apprehension that the joint will dislocate, guarding or pain, are positive responses for anterior instability, although pain is the more likely response in patients with subtle, non-traumatic instability. Applying an additional, anteriorly directed force has been shown to improve the test's sensitivity (discussed by Cavallo and Speer, 1998), but a problem of specificity remains, because a finding of pain is not unique to instability-related SIS.

Relocation test for anterior instability

This supplementary test is regarded as the most sensitive available for subtle instability (Cavallo and Speer, 1998). The anterior apprehension test is performed as above but, when the limit of available range is reached, a posteriorly-directed pressure is applied to the head of humerus. If apprehension, guarding, or pain is diminished by this manoeuvre, instability is likely.

Sulcus test

With the patient sitting, downward traction is applied through the humerus. The test is positive, i.e. indicative of multi-directional instability, if a hollow (sulcus) appears between the acromion and the head of humerus (Mahaffey and Smith, 1999).

Evidence summary

Useful tests for instability include:

- The anterior apprehension test
- The relocation test for anterior instability
- The sulcus test
- The load & shift manoeuvre

For explanation of absence of level of evidence, see paragraph 1.7.1.2

3.2.2.3 Tests of contractile function

Clinical assessment of contractile tissues around the shoulder typically includes *active movements* (which, while not specific to contractile tissues, provide valuable functional information), and *isometric actions against manual resistance*, done in mid-range in order to minimise tension on non-contractile tissues and increase specificity. A baseline *isometric* assessment traditionally comprises shoulder abduction and adduction with the arm by the side; medial and lateral rotation in a position of neutral humeral rotation with the elbow by the side and flexed to a right angle; and elbow flexion and extension in the same position. The principal structures putatively tested by these manoeuvres are:

Abduction	Supraspinatus (and deltoid)
Adduction	Teres minor
Lateral rotation	Infraspinatus, teres minor and possibly supraspinatus
Medial rotation	Subscapularis
Elbow flexion	Biceps and brachialis
Elbow extension	Triceps

Pain is held to denote a minor lesion, combined pain and weakness a more substantial lesion (e.g., a partial tear), and painless weakness either a neurogenic problem (such as suprascapular neuritis) or a complete tear of a cuff tendon (Cyriax 1982). Up to a point, these assertions appear to be valid. Itoi et al (1997), testing these actions with an isokinetic dynamometer, demonstrated pain and weakness, most marked into abduction (19–33% reduction in force) and lateral rotation (22–33% reduction in force), in patients with varying degrees of isolated supraspinatus tear. Use of local anaesthesia to abolish the pain routinely enhanced force production which, in the case of partial thickness tears, returned to near normal levels. Full thickness tears did not demonstrate so complete a recovery, presumably reflecting a structural inability to optimally transmit force. Both outcomes would appear to fit with conventional wisdom.

Yet some of Itoi et al's (1997) results were less predictable, suggesting complex interactions between contractile structures. Notably, adduction and medial rotation force were also impaired by isolated supraspinatus tears, and both improved after local anaesthesia, the latter significantly so, possibly reflecting the cuff's integrated stabilising role (Henk et al, 1997). Furthermore, Itoi et al (1997) failed to find the expected inverse relationship between the area (as opposed to the depth) of the tear and force. They explain this in terms of variable mingling and overlapping of individual tendons' fibres within the cuff. Atrophy, which may occur rapidly after cuff tear, is a further confounding variable, and considering these factors, as well as the fact that infraspinatus and subscapularis are now believed to contribute as much to abduction as supraspinatus (Otis et al, 1994, Sharkey et al, 1994), it would seem that isolating individual cuff muscles by manual testing might be harder than was previously supposed.

In view of such difficulties, Kelly et al (1996) sought to identify the isometric actions that would most effectively and selectively activate the individual rotator cuff muscles. An EMG analysis of supraspinatus, infraspinatus, subscapularis and five shoulder muscle synergists was therefore undertaken during various isometric actions in 11 normal subjects. For supraspinatus, resisted scaption at 90°, with the thumb pointing upwards, the 'full can' position, produced the greatest activation with the least concurrent activation of infraspinatus, and demonstrated excellent test-retest reliability (reliability coefficient 0.87). The alternative 'empty can' test, in which scaption is resisted with the thumb pointing downwards, when used on the above group, was marginally less specific and reliable.* The optimal action for testing infraspinatus was as for the traditional method, but with 45° of medial rotation at the shoulder: this minimised co-activation of supraspinatus and posterior deltoid and had excellent test-retest reliability (coefficient 0.71). Of the actions found to be reliable for testing subscapularis, the 'Gerber push with force' test (reliability coefficient 0.94) resulted in the greatest activation of this muscle with least co-activation of the pectoral and latissimus dorsi muscles. In this test the patient, who is sitting, rests the dorsum of the hand against the small of his or her back at waist-belt level, then attempts to lift it off posteriorly against the examiner's resistance.

* In clinical use, the 'empty can' test is more liable to hurt, but the pain is as likely to be due to positional impingement as it is to tension in supraspinatus, so its implications are ambiguous: the 'full can' test is therefore preferred (Itoi et al, 1999)

Evidence summary

The most effective and selective muscle tests for the rotator cuff are:

- The 'full can' test for supraspinatus
- The 'Gerber push with force' test for subscapularis
- Resisted lateral rotation from 45° of medial rotation for infraspinatus

For explanation of absence of level of evidence, see paragraph 1.7.1.2

These modified isometric tests may be substituted for those in standard use but, since they involve testing in non-neutral joint positions, it is important to be clear as to whether the non-contractile or contractile tissues are the source of any pain evoked.

A question arises as to how contractile force might be quantified and recorded. The 0–5 scale is inappropriate, since it relates to isotonic, not isometric muscle actions, and also because, in this patient group, nearly all scores would fall within grades 4–5. On the basis of anthropometric measures, Dvir (1997) has calculated that shoulder muscles assessed as grade 4 may generate as little as 20% of their maximal force. Isokinetic dynamometers are costly, not accessible to all and, in any event, impractical for everyday use. However, the use of a digital 'isometric' dynamometer should be considered. Hand-held isometric dynamometers are available, as well as 'fixed' versions that can be temporarily attached to bars or benches. Brinkmann (1994) has reported the two types to be interchangeable when measuring the relatively low forces generated by patients with neuromuscular disease (Pearson correlation coefficients 0.76–0.90). In musculoskeletal practice, though, higher forces might be encountered, and if the therapist's strength and technique are inadequate to resist the patient's effort, then it is the therapist's, not the patient's, strength that will be measured by a hand-held device. For this reason, 'fixed' type dynamometers would seem theoretically preferable, but research evidence has not substantiated this. Phillips et al (2000) 'break' tested 17 upper- and lower limb muscle groups in a convenience sample of 200 normal subjects aged 20–69 years using a hand-held dynamometer, and demonstrated reliability coefficients of > 0.85 for both intra- and intersession reliability for all groups except the ankle dorsiflexors. Hand-held dynamometers' great advantage is their ease of application.

3.2.2.4 Specific tests for complete cuff tears

Drop arm test

The patient actively abducts the shoulder to 90° before being asked to lower it slowly. The test is positive if the arm immediately drops with pain. This is a highly specific test for a cuff tear, and, if it is positive, such a lesion is near certain. The converse does not hold true, however, so a negative drop arm test does not prove the absence of a tear (Dinnes et al, 2003).

Lift off test

This is 'Gerber's push with force test' performed without resistance. If the patient is unable to actively lift the dorsum of the hand from his or her back, in spite of having adequate passive range, a subscapularis tear is almost certainly present (Dinnes et al, 2003).

3.2.2.5 Specific impingement tests

Commonly used impingement tests include Neer's test, the Hawkins-Kennedy test and the painful arc.

Neer's test

As originally described, this test is in two parts. First, the clinician forcibly flexes the sitting patient's arm, preventing scapular movement by pressing down on the clavicle and acromion with the other hand. This is painful in impingement, but in other conditions too. In impingement, though, injection of local anaesthetic into the subacromial space abolishes the pain on testing. The injection and retest comprise the second part of Neer's test (Neer, 1983) but, in practice, are often omitted. A shoulder medial rotation component was not specified in the original description of the test, but has come to be assumed by other workers, including Valadie et al (2000) who have demonstrated the anatomical validity of Neer's test – thus modified – and the Hawkins-Kennedy test, on cadavers. In the Neer's test position, contact between the greater tuberosity and lateral acromion was demonstrated in

3/5 specimens, soft tissue contact on the medial aspect of the acromion in 5/5. In 3/5 the long head of biceps tendon lay beneath the acromion, and in 1/5 the coracoacromial ligament (it could not be seen in the remaining specimen). In the two specimens in which the coracoacromial ligament could be visualised, the ligament was in contact with the lesser tuberosity in one, and both tuberosities and the biceps tendon in the other. In 5/5 specimens there was evidence of contact between the joint side of the cuff tendons and the glenoid rim either superiorly or anteriorly (Valadie et al, 2000).

Hawkins-Kennedy test

The clinician positions the patient's arm at 90° of forward flexion, then forcibly internally rotates the shoulder. This test aims to reproduce the patient's pain by 'impaling' the supraspinatus tendon against the underside of the coracoacromial ligament (Hawkins and Kennedy, 1980). In Valadie et al's (2000) cadaveric study, shoulders placed in the Hawkins-Kennedy position demonstrated contact between the greater tuberosity and lateral acromion in 1/4 specimens; between the bursal side of the cuff tendons and the medial acromion in 2/4; and between the cuff or biceps tendon and the coraco-acromial ligament in 4/4. The biceps tendon lay under the coraco-acromial ligament in 2/4 specimens, and in all 4 there was contact between the joint side of the cuff tendons' and the glenoid rim anterosuperiorly.

The anatomical rationales for the Neer and Hawkins-Kennedy tests are therefore sound. In addition, these tests' diagnostic accuracies have been evaluated in studies using subacromial local anaesthesia and arthroscopic appearances, respectively, as 'gold standards' (Calis et al, 2000; MacDonald et al, 2000). Calis et al (2000) and MacDonald et al (2000) reported sensitivities of 75% and 88.7%, respectively for Neer's test, and both reported 92% sensitivity for the Hawkins-Kennedy test. But specificities were much lower: 30.5% and 47.5% for Neer's, and 25% and 44.3% for the Hawkins-Kennedy. The clinical implication is that a positive test response cannot be confidently ascribed to impingement; but that if there is a negative response, impingement is very unlikely.

Painful arc

Painful arc is usually elicited during active elevation or lowering through the coronal plane, and is characterised by onset and offset of pain somewhere in the 60°–120° range (Kessel and Watson, 1977). Calis et al (2000) evaluated impingement tests against a criterion of subacromial local anaesthesia in 125 relatively unselected patients with shoulder pain, and reported a sensitivity of 32.5%, much lower than those of Neer's and the Hawkins-Kennedy's tests. But the painful arc was much more specific (80.5%). This would suggest that impingement cannot be ruled out on the strength of a negative response; but can probably be ruled in if an arc is present.

A large retrospective study by Litaker et al (2000) has yielded conflicting results, i.e. a sensitivity value of approximately 100%, and specificity of approximately 10%, for painful arc (and a highly modified Neer's test). But these results may be misleading. Only cuff tears were counted as true positives, so painful arcs rightly identifying other cuff pathologies or bursitis would have registered as false positive results. In addition, double contrast arthrography, the diagnostic gold standard used, is of doubtful validity.

On the other hand, as demonstrated by Yamakado (2002) and others, single diagnostic blocks are themselves not necessarily reliable; but the level of agreement between Calis et al (2000) and MacDonald et al, (2000) in respect of other impingment tests provides reassuring convergent validity.

Evidence summary

- Negative Neer & Hawkins-Kennedy tests largely rule impingement out, but positive results do not rule it in with any certainty.
- A 'painful arc' probably rules impingement in; but the absence of an arc does not rule it out with any certainty.

For explanation of absence of level of evidence, see paragraph 1.7.1.2

3.2.2.6 Differentiation from other, intracapsular, causes of impingement

Internal rotation resistance strength test

Pain on impingement tests may indicate intra-articular lesions (SLAP lesions, minor instability and PSGI) and a number of tests have been developed to differentiate between these and the more common causes of impingement. The internal rotation resistance strength test (IRRST) has been described by Zaslav (2001). The patient stands with the arm held in 90° abduction and 80°–85° external rotation. In this position a manual isometric muscle test of external rotation, then internal rotation, is performed, and the strength of the two movements compared. (No contralateral comparison is made, because the test is of relative weakness in a 'pathologic' shoulder). If, in a patient with signs of impingement, external rotation is strong but internal weak, the test is regarded as positive for internal impingement. Zaslav (2001) speculates that isometric internal rotation pushes the head of humerus anteriorly, tensioning the capsulolabral border and biceps-labral complex, magnifying the pain of subtle subluxation and biceps and SLAP lesions, and causing apparent, rather than actual, weakness. The mechanism by which this test would identify posterior-superior impingement is less clear-cut. Comparison with arthroscopic findings indicates that the IRRST is highly sensitive (88%) and specific (96%) in differentiating between subacromial impingement and intra-articular impingement (Zaslav, 2001), although these results have not been independently verified.

3.2.2.7 Palpation

Optimal positions for accessing the rotator cuff and biceps tendons have been described by Mattingley and Mackarey (1996) on the basis of cadaveric work.

Supraspinatus

The distal tendon is maximally exposed with the least amount of overlying tissue in the forearm-behind-the-back position with maximal adduction (10°) and hyperextension (30°–40°). It then lies immediately anterior to the acromio-clavicular joint, but cannot be distinguished by touch: attempting to localise it by resisting shoulder abduction and feeling for increased tension is unhelpful, since this action also tenses the overlying deltoid.

Infraspinatus and teres minor

The optimal position is 90° of shoulder flexion, 10° of adduction and 20° of lateral rotation, and whether this is achieved in sitting or lying appears to be irrelevant. The distal tendon lies immediately inferolateral to the angle of the acromion. The distal teres minor tendon is immediately inferior to that of infraspinatus.

Subscapularis and the long head of biceps

The subscapularis tendon is brought into the deltopectoral triangle (and therefore superficial) by positioning the shoulder in neutral abduction-adduction and neutral rotation. Slight medial rotation (20°) brings the long head of biceps' tendon, in its groove, into the triangle.

These positions broadly agree with those previously described by Cyriax and Cyriax (1993).

4

Recommendations for diagnosis/assessment

4.1 History

This should specifically establish:

- **The patient's age**

  SIS
  This may occur at any age, but in patients under 35 years old is likely to be secondary to instability.

  PSGI & SLAP
  For both, the mean age is approximately 35 years (range approximately 18–55).

  Capsulitis
  The usual age range is 40-60 years.

- **How the problem started**

  SIS
  The onset may be sudden or insidious.

  PSGI
  This is usually related to throwing or an analogous injury/activity.

  SLAP
  SLAP lesions are usually attributable to specific, throwing-related incidents.

  ACJ arthritis
  Symptoms usually develop many years after an injury.

- **The nature of the symptoms**

  Various symptoms, and their likely implications, are presented in table 4.1.

- **The intensity of the pain**

  Use a VAS or equivalent.

4.2 Functional status

The patient's functional status should be determined using an appropriate, validated tool e.g., Disabilities of the Arm, Shoulder and Hand (available from Institute for Work & Health, 481 University Avenue, Suite 800, Toronto, ON M5G 2E9. FAX: 416-927-4167; DASH@iwh.on.ca; or http://www/iwh.on.ca).

Table 4.1 Differential diagnosis: a summary of shoulder symptoms.

Symptom:		Condition: SIS	SIS secondary to instability	PSGI	SLAP	Capsulitis	ACJ arthritis
Pain	Shoulder/ deltoid. May radiate into arm	+	+			+	
	Local to ACJ						+
	Posterior			+			
	Inside joint/ vague				+		
	Sharp/ catching	+	+				
	Aching	+				+	+
	At night	Possible: suggests cuff tear	Possible, but minor	Possible, but minor		Possible	
	Lying on affected side	Possible: suggests cuff tear				Possible	Possible
	Activity specific	+ Especially overhead work	+ As for SIS	+ Throwing or similar	+ Not consistent	Possible	+ Ache after general activity
Dead arm			Possible				
Heavy feeling			Possible				
Painful clicking			Possible		Possible		Possible
Crepitus		Possible: suggests partial cuff tear?					Possible

4.3 Physical assessment

4.3.1 Inspection

With the patient in standing and sitting (both positions may be pertinent), look for:

- 'Forward head' posture
- Excessive thoracic kyphosis.

Also look for:

- Muscle atrophy, especially of the spinati
- Bruising, which may accompany cuff tears.

The value of assessing static scapular posture is doubtful, but look for:

- Definite scapular winging, which may raise suspicions of serratus anterior dysfunction as in long thoracic neuritis. This may be further evaluated by inspecting for winging while the patient protracts against resistance, e.g., pushing, one-armed, against a wall.

On active scaption, look for:

- Reduced scapular rotation in the middle third of range. Abnormality may be accentuated when the scaption movement is performed against resistance in the order of 2.5 Kg (Ludewig and Cook, 2000).
- Other disturbance of scapulohumeral rhythm which may be associated with a painful arc.

Comparison with the unaffected side is not foolproof, but the best available benchmark of normality.

Any of these factors may be associated with SIS.

4.3.2 Physical tests

4.3.2.1 Range of movement

Preliminarily clear the cervical spine as a source of symptoms.

Evaluate the mobility of the thoracolumbar spine (during elevation, the shoulder must compensate for stiffness here) and, as far as possible, localise any stiffness found.

Then, at the shoulder, evaluate:

- Active range and
- Passive range.

Note the presence or absence of pain as well as the available range of movement for each. The GDG recommends that an inclinometer be considered for measuring composite elevation and shoulder lateral rotation, the latter with the patient supine and the elbow adducted.

At the present time, there is no evidence that pure medial rotation can be measured reliably. This is unfortunate, because limitation reflects posterior capsular tightness, which seems to be associated with SIS. A gross impression of medial rotation range may be formed by visual comparison with that of the unaffected side. Alternatively the 'thumb up back test' may be used, in which the clinician records the highest vertebral level reached. This tests more than medial rotation, of course, and also depends on the therapist's ability to identify the relevant spinal level. Passive horizontal adduction evaluates the extensibility of the posterior capsule too, and should be included. The technique is described in section 3.2.2.1.

Possible findings on range of movement testing, and their likely implications, are shown in table 4.1.

4.3.2.2 Instability

These comprise the following:

- Load and shift manoeuvre
- Anterior apprehension test
- Relocation test for anterior instability
- Sulcus test

All are explained in section 3.2.2.2 and placed in broader context in table 4.1. They may be regarded as redundant in the > 35 age group, provided there is no history of major trauma.

4.3.2.3 Contractile function

Rotator cuff

Test the relevant muscles isometrically against maximal resistance. The GDG recommends that a hand-held dynamometer be considered for quantifying contractile force. Pain implicates the cuff, and cuff tears are associated with weakness. In the case of partial tears this is probably due to pain inhibition. The most specific tests for the cuff muscles are:

- The 'full can' test for supraspinatus
- Resisted lateral rotation from a position of 45° medial rotation for infraspinatus
- The 'Gerber push with force' test for subscapularis.

These tests, which are defined in section 3.2.2.3 are performed in non-neutral joint positions, so it is important to ensure that the positions are painless before testing.

If a cuff tear is suspected, additional tests may be conducted. These include:

- The drop arm test, for supraspinatus, positive if the patient is unable to slowly lower his or her affected arm from 90° elevation due to pain
- The lift off test, for subscapularis, positive if the patient cannot lift the dorsum of his or her hand from the small of the back.

Biceps

Biceps should also be evaluated. This may be done by means of:

- Isometric flexion at 90° elbow flexion (Cyriax, 1982)
- Yergason's test: isometric supination at 90° of elbow flexion (Calis et al, 2000)
- Speed's test: flexion of a straight, supinated arm from 0-60° against resistance (Calis et al, 2000).

The sensitivity and specificity of Yergason's and Speed's test have been evaluated in relation to SIS using subacromial local anaesthesia as a gold standard, but this sheds little light on their usefulness as specific indicators of biceps pathology (Calis et al, 2000).

4.3.2.4 Impingement tests

The following tests are of value. (All are explained in section 3.2.2.5 and put into broader context in table 4.2):

- Painful arc
- Neer's test
- Hawkins-Kennedy test

If a painful arc is positive, SIS is very likely. Conversely if the Neer's and Hawkins-Kennedy tests are negative, impingement is very unlikely.

- Internal rotation resistance strength test for internal impingement

This is a sensitive and specific means of differentiating intra-articular impingement from SIS.

4.3.2.5. Palpation

If localised treatment is contemplated, palpation for tenderness should be conducted, positioning the patient so as to maximally expose the tendons (see section 3.2.2.7).

Table 4.2 Differential diagnosis: a summary of movement, impingement and instability tests.

Sign:		Condition: SIS	Instability	PSGI	SLAP	Capsulitis	ACJ arthritis
Painful active	Arc	Possible	Possible				Possible
	Elevation	Possible	Possible	+	+	+	Possible
Medial	Possible rotation	Possible			+	Possible	
	Lateral rotation		+ In the apprehension test position	+		+	Possible
	Horizontal adduction	Possible	As for SIS			N/a	+
Limitation of active	Elevation	Possible. In a cuff tear active elevation may not be achievable	Possible			+	
	Lateral rotation					+	
	Medial rotation	Possible	Possible			+	
Limitation of passive	Elevation	Possible	Possible			+	
	Lateral rotation					+	
	Medial rotation	Possible	Possible			+	
	Horizontal adduction	Possible	Possible			N/a	

Sign:		Condition: SIS	Instability	PSGI	SLAP	Capsulitis	ACJ arthritis
Positive	Neer	+	Possible		Possible	N/a	N/a
	Hawkins-Kennedy	+	Possible		Possible	N/a	N/a
	Load and shift		Possible	Possible	Possible	N/a	
	Apprehension		+		Possible	N/a	N/a
	Relocation		+		Possible	N/a	N/a
	Sulcus test		Possible		Possible	N/a	N/a
	IRRST		+	+	+	N/a	N/a

Diagnostic imaging

5.1 Radiographs

Antero-posterior radiographs enable visualisation of:

- Calcific tendinitis (Bigliani and Levine, 1997)
- Acromial morphology (Morrison et al, 1997).

They are of very limited value in stage I impingement (Hawkins and Abrams 1987). In more advanced cases they may enable visualisation of:

- Subchondral cysts or sclerosis of the greater tuberosity; possibly with corresponding sclerosis or spur formation at the acromion
- Osteoarthrosis of the acromioclavicular (or indeed glenohumeral) joint (Bigliani and Levine, 1997).
- The acromiohumeral interval. In a normal shoulder, this measures 7–14mm. A reduction may indicate a cuff tear (Magee, 1997).

5.2 Ultrasound, magnetic resonance imaging (MRI) and magnetic resonance arthrography (MRA)

Dinnes et al (2003) have systematically reviewed studies into the diagnostic accuracy of ultrasound, MRI and MRA for rotator cuff tears. They conclude that both ultrasound and MRI may be able to provide convincing evidence of full-thickness tears, but that the implications of negative results are equivocal. With respect to partial tears, though better than MRI, ultrasound's accuracy is probably poor. Dinnes et al (2003) tentatively report that MRA may be accurate in the detection of both full and partial thickness tears, but that further evidence is required to confirm this, and caution that any potential benefits must be balanced against its invasiveness and potential discomfort. Physical examination clearly remains relevant.

Evidence summary

- Radiographs enable visualisation of calcific deposits.
- Radiographs are of limited value in stage I impingement, but may show bony changes in the later stages.
- Positive identifications of full-thickness tears by ultrasound and MRI are probably reliable.
- Neither ultrasonography nor MRI is accurate at determining the presence/absence of partial thickness tears.
- MRA is invasive and its accuracy is uncertain.

For explanation of absence of level of evidence, see paragraph 1.7.1.2

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6

Aims and objectives of physiotherapy for shoulder impingement syndrome

6.1 Aims

- To minimise pain
- To optimise function
- To appropriately refer those patients who are unresponsive to physiotherapy

6.2 Objectives

- To reduce subacromial inflammation and manage pain
- To improve posture
- To restore range, strength, stability and scapulohumeral rhythm
- To identify when patients should be referred for an orthopaedic opinion

Evidence underpinning the physiotherapy management of SIS, including SLAP lesions and PSGI

The conservative management of SIS, SLAP lesions, and PSGI follows similar lines. Differentiation between the physiotherapeutic management of SIS and SLAP lesions would be unrealistic because of the overlap between these conditions (discussed in Section 2) as well as the difficulty of differential diagnosis. A SLAP lesion may remain unsuspected till revealed arthroscopically in an 'unresponsive' shoulder. On the other hand, it is not known what proportion of SLAP lesions do respond to conservative management and consequently never come to arthroscopic diagnosis.

7.1 Reduction of subacromial inflammation and pain management

7.1.1 Rest, avoidance of aggravating activities, and non-steroidal anti-inflammatory drugs

There is consensus that the initial management of SIS should involve relative rest and avoidance of aggravating factors; particularly overhead activities in SIS or, in PSGI, pain-provoking positions (Jobe, 1997). This seems a reasonable principle because, as previously discussed, pain inhibits shoulder muscle function. In 'impingement/instability overlap syndrome', Parker and Seitz (1997) advocate the use of a sling for 7–10 days, interrupted only by twice-daily pendular exercises, but this should be advised with caution for fear of precipitating pain-related illness behaviour. Such strict rest should never be advised in the over 40s, in whom adhesive capsulitis may result (discussed by Winters et al, 1999a).

Avoidance of aggravating activities is usually combined with non-steroidal anti-inflammatory medication (NSAIDs) aiming to hasten resolution of pain and inflammation (e.g., Jobe 1997, Morrison et al 1997). Buchbinder, Green and Youd (2003) systematically reviewed RCTs of NSAIDs versus placebo for rotator cuff tendinitis, pooling the results of the two studies with the highest methodological scores. These pooled results suggested that NSAIDs were superior in improving the range of abduction (weighted mean difference [WMD] +26°; confidence intervals -9° to +61°, where '+' values denote improvement). The improvement did not differ significantly according to the NSAID used (naproxyn or diclofenac). The WMD for pain was +3% (confidence intervals –19% to +25%), where '+' values denote deterioration. The reviewers urge caution in the interpretation of these results, however, since neither of the RCTs concerned was strong methodologically (scoring 16/40 and 22/40, respectively), and considerable manipulation of inadequately presented results was required to pool their data. Studies into the efficacy of NSAIDs versus analgesia for SIS are lacking. However, moderate to severe osteoarthritic pain is known to be more responsive to oral NSAIDs than to paracetamol (Towheed et al, 2003), and extrapolating from these results would appear to justify the use of NSAIDs in the present context, in spite of the known adverse effects, and especially since only short courses (7–21 days) are recommended in SIS (Rodgers and Crosby 1996, Parker and Seitz, 1997, Morrison et al, 1997).

Speed and Hazleman (2003) reported withdrawal due to NSAID-related adverse events in less than 10% of patients in non-randomised comparative studies for shoulder pain, rising to 20% in RCTs. The events were mainly gastrointestinal symptoms, skin rash, headache or dizziness: there was no evidence that their nature or severity varied in relation to the particular analogue used.

At the time of writing it is medico-legally inappropriate for a physiotherapist to recommend medication directly to a patient, even if it is available over the counter. The physiotherapist should suggest that the patient discusses medication with his or her medical practitioner, or approach the practitioner on the patient's behalf.

One moderate quality RCT has shown that peri-articular injection of tenoxicam versus placebo benefits the pain and stiffness of rotator cuff tendinitis (Itzkovitch et al, 1996).

Evidence summary

	Level
• Relative rest and avoidance of aggravating activities are beneficial in the early management of SIS, allowing pain and inflammation to settle.	III
• Absolute rest is very rarely necessary, and risks precipitating pain-related illness behaviour and adhesive capsulitis.	IV
• The potential benefits of a short (7–21 day) course of NSAIDs outweigh the risks.	Ia

Recommendation

	Grade
Rest	
• Initially, relative rest should be recommended: overhead or other aggravating activities should be avoided in particular.	B
• Absolute rest should be avoided.	C
NSAIDs	
• The benefits of a short (7–21 day) course of NSAIDs are likely to outweigh the risks. If such medication has not been prescribed, this option should be discussed with the appropriate medical practitioner.	A

7.1.2 Cold therapy

The Philadelphia Panel (Albright et al, 2001) and Green et al (2003) found insufficient evidence to specifically confirm or refute the efficacy of cold therapy in relation to SIS; but van der Heijden et al (1997) reported one non-English language RCT which showed it to be ineffective for shoulder pain.

Even so, this modality is widely advocated in the literature. Hawkins and Kennedy (1980) and Hawkins and Abrams (1987) recommend cold packs after exercise in order to prevent reactive inflammation; cold packs are also recommended, as a means of reducing inflammation by Zuckerman et al (1991), Rodgers and Crosby (1996) and Donatelli (1997). The general consensus is that cold usually achieves its optimal effects – in terms of reduced pain, blood circulation and metabolism – within 20–30 minutes of application (Kerr et al, 1998). Thirty minutes may be necessary in the obese, but should never be exceeded, so as to avoid damage to skin or deeper tissues, including nerves. In very thin patients, applications should be limited to 10 minutes. Interposing a layer of damp towelling between the ice pack and the patient's skin reduces the small risk of ice burns (Kerr et al, 1998).

Potentially irritative activites should be carefully avoided while cold-induced analgesia persists, especially in SIS, since animal studies suggest that cold therapy may increase, rather than reduce, oedema (discussed by Kerr et al 1998). Other hazards of cold packs are documented in standard textbooks (e.g., Low and Reid, 2000).

Evidence summary

	Level
• Cold packs may help reduce the pain and inflammation of SIS, and help resolve irritation induced by exercise.	IV
• There is consensus that cold packs' optimal effects are usually achieved within 20–30 minutes of application. 30 minutes may be needed to achieve satisfactory results in the obese but, to reduce the risk of tissue damage, applications should never exceed this. In very thin patients, ice should be applied for only 10 minutes.	IV
• Application of cold packs prior to exercise is potentially harmful.	IIb
• The hazards of cold therapy are reviewed in standard textbooks.	III

Recommendation

	Grade
Cold therapy	
• Cold packs may be used to reduce the pain and inflammation of SIS, and to settle irritation post-exercise. Applications vary from a maximum of 30 minutes, which may be required to achieve satisfactory deep cooling results in the obese, to a minimum of 10 minutes in the very thin (in whom longer applications increase the risk of tissue damage).	C
• Cold packs should not be applied prior to exercise.	B

7.1.3 Heat therapy

No RCTs of heat therapy were included in the systematic reviews by the Philadelphia Panel (Albright et al, 2001) or Green et al (2003). However, van der Heijden et al (1997) cite two studies, both evaluating interventions for periarthritis* of the shoulder, and both with negative outcomes. One showed no significant differences between regimes combining exercise with, respectively, heat, intratendinous hydrocortisone injection, and intra-articular hydrocortisone injection; the other compared diathermy, hydrocortisone injection and analgesia, each in combination with exercises, and reported no significant differences.

The hazards of heat are documented in standard textbooks (e.g., Low and Reid, 2000).

Evidence summary

	Level
• There is insufficient evidence to support or refute the use of heat therapy in the management of SIS.	Ia
• The hazards of heat are documented in standard textbooks.	III

Recommendation

	Grade
Heat	
• Due to insufficient evidence, no recommendation can be made.	None

* This term, which has fallen into disuse, is defined as 'Inflammation of tissues around a joint capsule, including tendons and bursa' – Oxford Concise Medical Dictionary (1985). It therefore incorporates SIS.

7.1.4 Pulsed electromagnetic fields (PEMF)

Two RCTs of PEMF have been systematically reviewed by Green et al (2003), though pooling of data was not possible. In one, 30 minutes' daily PEMF for six consecutive days significantly improved the pain and stiffness of calcific tendinitis, both short-term and at six weeks. The other, weaker, study, in which data were not analysed quantitatively, yielded compatible results. The soreness following treatment is greater after PEMF than placebo, but there appears to be no lasting adverse effect (reviewed by Green et al, 2003). No other adverse effects have been reported.

Evidence summary

	Level
• PEMF improves the pain and stiffness of calcific tendinitis in the short- and medium-term.	Ia
• No lasting adverse effects have been reported.	IV

Recommendation

	Grade
Pulsed Electromagnetic Fields	
• PEMF (applied for 30 minutes on 6 consecutive days) is beneficial in the treatment of calcific tendinitis, both short- and medium-term. Though it is associated with post-treatment soreness, this is only transitory.	A

7.1.5. Ultrasound

One adequate RCT of ultrasound for calcific tendinitis demonstrated significant reduction in the size of the deposits, and clinically important benefits. But very high intensities were used (> 2 W/cm^2), the treatment was intensive (5 times weekly) and the benefits – which at two months post-intervention included pain reduction (77% relative to the control group) and improvement in functional status (15%) – had disappeared after nine months (reviewed by Albright et al, 2001 and Green et al, 2003). A question therefore arises as to the cost-effectiveness of the intervention, especially in relation to its potential risks. A further trial, reviewed by Green et al (2003) investigating the effect of acetic acid iontophoresis plus ultrasound showed no significant benefit in the treatment of calcific tendinitis.

With respect to general shoulder pain and rotator cuff disease, Green et al's (2003) meta-analysis of two RCTs showed no evidence that ultrasound is effective. Nor did two additional RCTs of ultrasound for shoulder pain, which they excluded from the meta-analysis but evaluated separately. These results agree with Albright et al's (2001) meta-analyses of four RCTs and their additional evaluation of cohort controlled studies (CCTs). Also in agreement is van der Heijden et al's (1997) systematic evaluation of four methodologically "acceptable" RCTs. With respect to shoulder pain, therefore, ultrasound appears to be effective only for calcific tendinitis. Possible adverse effects of this modality were not considered in any of the RCTs evaluated (Green et al, 2003).

Evidence summary

	Level
• Relative to placebo, ultrasound benefits calcific tendinits short- and medium-term. At nine months these benefits are no longer evident.	Ia
• Except for calcific tendinitis, ultrasound is not beneficial in SIS.	Ia
• No RCTs have reported on adverse effects	Ia
• Hazards are documented in standard textbooks.	III

Recommendation

	Grade
Ultrasound	
• In calcific tendinitis, high intensity (2.2 W/cm^2), continuous ultrasound, applied daily for three weeks, then on alternate days for three weeks, gives short- and medium-term benefit.	A
• Except in calcific tendinitis, ultrasound is not recommended for SIS.	A

7.1.6. Laser

A meta-analysis (Green et al, 2003) of three moderate-to-good quality RCTs comparing laser to placebo indicates that laser is not significantly superior in bringing about a "good" or "excellent" short-term result in SIS. A fourth RCT, which was excluded from the meta-analysis but considered separately, compared laser to NSAIDs, and demonstrated significant benefit for laser in terms of pain, function and range of motion. On cessation of treatment at 2 weeks, there was a between-median difference of 2.5 cms (confidence intervals 2,3) on a VAS for pain, 1.5 cms (-0.1,3.99) on a VAS for function, and 20° (10, 40) in range of abduction. But this RCT was only of moderate quality, and other systematic reviewers have questioned its validity (van der Heijden et al, 1997). Moreover its lack of follow up means that longer-term outcomes are unknown (Green et al, 2003). Adverse effects of laser have not been investigated.

7.1.7. Transcutaneous Electrical Nerve Stimulation (TENS)

Based on two poorly reported and/or conducted RCTs, there is no evidence that TENS is more effective in reducing the pain of shoulder disorders than ultrasound or other electrical methods (reviewed by van der Heijden et al, 1997): no studies met the inclusion criteria of the Philadelphia Panel (Albright et al, 2001) or Green et al (2003). No adverse effects have been reported (Low and Reid, 2000).

Evidence summary

	Level
• The evidence is contradictory but, on balance, laser does not appear to benefit SIS.	Ia
• TENS does not appear to benefit SIS.	Ia*
• RCTs of laser have not investigated adverse effects.	Ia
• The potential hazards of laser are reviewed in standard textbooks.	IV
• No adverse effects of TENS have been reported	IV

* Based on weak primary evidence

Recommendation

	Grade
Laser and Transcutaneous nerve stimulation	
• Due to insufficient evidence, no recommendation can be made.	None

7.1.8. Deep transverse friction massage (DTFM)

This technique, essentially a localised soft tissue mobilisation, is described in detail elsewhere (Cyriax and Cyriax, 1993, Kesson and Atkins, 1998). In the present context, it comprises massage applied at right angles to the fibres of a symptomatic tendon, which is made accessible as described in section 3.2.2.7. Liesdeck et al (1997), who characterised the interventions of 13 physiotherapists for 120 patients with shoulder pain, reported that DTFM was used in 97% of cases of tendinitis.

Clinical experience indicates that DTFM reliably induces analgesia (thereby facilitating function), and there is some weak experimental evidence supporting this (de Bruijn, 1984, Brosseau et al, 2003). It is also believed to optimise the disposition of collagen, preventing or reducing tendon thickening, which would be a useful contribution to the management of SIS (Kesson and Atkins, 1998). In chronic cases, where it is applied relatively firmly, the hyperaemia induced may help disperse chemical irritants (Kessler and Hertling, 1996, Kesson and Atkins, 1998).

To an extent, deep massage's postulated influence on collagen is supported by animal work, which also demonstrates functional benefits. Davidson et al (1997) evaluated the effects of deep (albeit longitudinally oriented) massage on collagenase-induced achilles tendinosis in rats. Four randomly allocated groups of 5 were studied: (a) a control group; (b) a tendon-injured group; (c) a tendon-injured group briefly treated by firm massage on days 21, 25, 29 and 33; and (d) a non tendon-injured group similarly treated by massage. Gait analysis was undertaken preliminarily, and on days preceding 'massage days'. The animals were sacrificed, and their tendons prepared for microscopy, 10 days after the last session of massage. Only the animals in group (c) significantly improved their running performance after injury, having regained their original gait patterns by the end of the study. Fibroblastic proliferation was seen in groups (b) and (c), with the largest significant increment in the latter. In order to initiate collagen synthesis, fibroblasts must not only proliferate, but also activate. Activation was observed in both tendon-injured groups, as might be expected but also, less expectedly, in the massage-only group. Increments in fibronectin (a molecule synthesised by fibroblasts and epithelial cells, which binds the extracellular substance and collagen) were also observed in the tendon-injured groups and the massage-only group. It would therefore seem that massage is of itself a stimulus to fibroblastic activation and fibronectin synthesis, both critical processes in tendon repair. Group (c) did not demonstrate benefits in collagen disposition over group (b), possibly because of the short timeframe involved; though the authors speculate that, with earlier restoration of function, the stresses of normal use would promote realignment sooner.

There is some dispute over how early DTFM may safely be started following tissue injury. Work on rodents has shown that 3 days' active mobilisation starting 5 days post achilles tenotomy enhances repair, whereas a similar period of mobilisation started at day 2 impedes it (Enwemeka et al, 1988). Though tendon healing in rodents does not directly relate to that in humans, this has led to concerns that passive mobilisation techniques (and DTFM in particular) should not be applied earlier than the 5th day following injury (Hunter 1994, 1998).

However rats allowed to swim post achilles tenotomy suffer no detrimental effect (Murrell et al, 1998). And, again in rats, Hart and Dahners (1987) have shown that free activity following medial collateral knee ligament transection enhances stability, providing that, at operation, the secondary stabilising structures of the joint are left intact, thereby providing some measure of protection. Furthermore, mobilisation of repaired human finger tendons commencing on the first day post operatively appears to be beneficial, providing it is performed gently (Becker et al, 1979). Taken together, these findings do seem to suggest that the degree of stress applied to tissues in the early stages of repair might be critical, with strong stress being harmful, minimal stress harmless and potentially beneficial.

There is no specific evidence of DTFM's efficacy, or otherwise, for shoulder tendinitis (Kesson and Atkins (1998), Albright et al (2001), Brosseau et al (2003)).

Evidence summary

	Level
• DTFM is commonly used therapeutically in shoulder tendinitis	III
• DTFM is believed to optimise collagen disposition	Ia
• A rodent tendinosis model shows that deep massage significantly enhances fibroblast proliferation, fibroblast activation, and fibronectin synthesis, and significantly accelerates restoration of function.	Ib
• The timing for safe application of DTFM after injury (i.e. 5 days or sooner) is disputed, but the pressure with which it is applied may be critical.	III-IV

Recommendation

	Grade
Deep transverse friction massage (DTFM)	
• Due to insufficient evidence, no recommendation can be made	None

7.1.9 Steroid injection

A number of studies indicate that steroid must be accurately placed in order to achieve an optimal therapeutic effect. Hollingworth et al (1983), reviewed by Buchbinder et al (2003), found the results of injection into anatomical structures, identified using Cyriax's system of diagnosis (Cyriax, 1982), superior to trigger point injection for general shoulder pain. Eustace et al (1997) reported similarly significant benefits only in a subgroup of 4 of 14 subacromial injections which were accurately targeted. The poor 'hit' rate reflects the technical difficulty involved in subacromial injection, and this point is emphasised by Yamakado (2002), who radiographically evaluated the outcome of 56 attempted subacromial injections for SIS, and judged only 39 of them to have reached the target site. Furthermore, Partington and Broome (1998) assessed the fate of injections aimed at the subacromial space in 24 cadaveric shoulders. These reached the target in 20 cases, but in 15 shoulders other structures were inadvertently infiltrated, including the rotator cuff in seven. The disparate degrees of accuracy reported in these studies may relate to differences in individual injectors' skills and unfortunately, imprecise injection technique may be reinforced by the fact that some patients transiently improve immediately post-injection, even if this has missed the target structure (Yamakado, 2002). Unfortunately, few studies have used imaging techniques to confirm injection placement. In general, these considerations make it difficult to draw clear conclusions from the literature.

Buchbinder et al (2003) pooled data from two well-conducted studies comparing steroid injection with placebo, yielding a total of 45 patients per intervention group (Adejabo et al, 1990; Petri et al, 1987). Both studies had used single injections of the steroid analogue triamcinilone hexacetonide – Adejabo et al (1990) at the very high dosage of 80 mg, Petri et al (1987) at 40 mg – and injection placement had been confirmed ultrasonically in the latter. Meta-analysis indicated a small benefit of subacromial injection over placebo in terms of pain, function and range of abduction at 4 weeks. Five other trials comparing subacromial steroid injection with placebo were considered, but could not be pooled: these varied in terms of quality, the steroid used, dosage and outcome.

Adebajo et al (1990) and Petri et al (1987) also evaluated the efficacy of subacromial injection in relation to NSAIDs. Buchbinder et al (2003) subjected these data to meta-analysis with those of a third, poorer quality trial whose steroid group had receieved an injection of 40 mg triamcinilone acetonide, repeated after 3 weeks if necessary (White et al, 1986). The NSAID comparators were 50 mg diclofenac 3 times a day for 28 days (Adebajo et al, 1990); 500mg naproxen twice a day for 30 days (Petri et al, 1987); and 25 mg indomethacin 4 times daily, with a repeat prescription after 3 weeks if required (White et al, 1986). No benefit of subacromial steroid injection over NSAID was demonstrated with respect to improvement in pain, function or range of shoulder abduction at four or six weeks. Petri et al (1987), using the drugs and dosages described above additionally compared the efficacy of steroid injection plus NSAIDs to NSAIDs alone (reviewed by Buchbinder et al 2003), but showed no additional benefit for the combined therapy.

Buchbinder et al (2003) conclude that evidence does support the use of subacromial corticosteroid injection for rotator cuff disease, although its effect may be small and not well maintained, and it may not be superior to NSAIDs.

Winters et al (1997, 1999b), produced a methodologically poor trial reviewed by Green et al (2003), evaluating treatment for symptoms arising from synovial structures in and around the shoulder. Intra-articular and subacromial injections were compared (average 1.8 injections of 40 mg triamcinilone acetonide) to manipulative and non-manipulative physiotherapy, respectively. Significant benefit was demonstrated for injection up to 11 weeks. However, a review at 2 years showed no long-term difference between groups.

It is unfortunate that, with few exceptions, the research literature does not reflect the complementary ways in which different therapies are used clinically. In reality, NSAIDs, 'physiotherapy' and steroid injection are not necessarily 'stand-alone' approaches, especially now that injection is within appropriately trained physiotherapists' scope of practice. Indeed, most authorities view steroid injection as an adjunct rather than an alternative to rehabilitation (e.g., Rodgers and Crosby, 1996), especially where SIS secondary to instability is concerned (Kamkar et al, 1993). But opinion is divided on whether it should routinely precede rehabilitation or be reserved for cases in which pain and inflammation hamper the rehabilitative process. Most favour the latter, considering injection to be indicated, variously, after 'several weeks' (American Academy of Orthopaedic Surgeons, 2001), '4-6 weeks' (Zuckerman et al, 1991) or simply if the impingement does not 'improve with conservative treatment' (Fongemie et al, 1998). Circumstances might be envisaged, with acutely painful shoulders, in which steroid injections are necessary before adequate rehabilitation can properly commence, but their use should be tempered by an awareness that they are not risk free. Injection may compromise the tensile strength of collagen for up to 14 days, and some authorities have also voiced concerns as to a link between steroid injections and tendon rupture (discussed by Kesson et al, 2002). Efforts to avoid intratendinous injection, and diminish such a risk, cannot be guaranteed of success, to judge from Partington and Broome's (1998) cadaveric study (discussed above). In any event, not more than three injections should be administered (Shankwiler and Burkhead, 1994); and in view of collagen's potential vulnerability, it would seem prudent to withhold resistive exercise for a fortnight after each. For a summary of the other hazards of steroid injection, see Kesson et al (2002). On balance, a reasonable approach would seem to be one where pharmacological interventions are used complementarily, to help facilitate the exercise and mobilisation at the "core" of the rehabilitation effort (see section 7.3). This should maximize clinical benefits, while avoiding the hazards of either prolonged use of NSAIDs or injudicious steroid injection therapy.

Evidence Summary

	Level
• Steroid injections benefit SIS in the short term.	Ia
• Steroid injection is typically considered an adjunct, rather than an alternative, to rehabilitation. Although this view is not universally held, most authorities advocate injection if the SIS is unresponsive to some weeks' conservative treatment.	IV
• Steroid injections may compromise the tensile strength of collagen for up to 14 days. Resistive exercise should be avoided during this time.	III
• Studies into the accuracy of injection placement have shown disappointing results, including inadvertent intratendinous injection. In the clinical setting, such placement would increase the risk of tendon damage.	III
• The same subacromial space should not be injected on more than 3 occasions.	IV

Recommendation **Grade**

Steroid injections

- Steroid injections benefit SIS in the short term. A
- In view of the associated risks, it is suggested that steroid injections be used only as needed to facilitate rehabilitation. It is also suggested that normally, unless severe pain is present, a several-week trial of more conservative therapy should precede their use. C
- Resistive exercise should be withheld for 2 weeks following steroid injection. B
- The same subacromial space should not be injected on more than 3 occasions. C

7.2 Improvement of posture

Forward-head posture has been implicated in SIS (Greenfield et al, 1995). Where this is present, therefore, an effort should be made to improve it.

Evidence summary **Level**

- There is an association between forward-head posture and shoulder pain. IIa

Recommendation **Grade**

Improvement of posture

- An attempt to correct forward-head posture is appropriate, in view of its association with shoulder pain. B

7.3 Restoration of range, strength, stability and scapulohumeral rhythm

The outlook for conservatively managed SIS is hopeful. In their descriptive study, Morrison et al (1997) reported an excellent or satisfactory result in 67% of 636 shoulders with simple stretches and resisted internal and external rotation exercises. The outcome was better in younger patients, in those with acute problems, and in those with type I acromions.

Brox et al (1993, 1999) evaluated cases of SIS which had proved resistant to standard conservative interventions in an RCT and 2-year follow up. Patients were randomised to a daily regime of supervised low resistance exercises (plus education), arthroscopic surgery or detuned (placebo) laser, and both of the active interventions yielded comparable functional benefits that were statistically and clinically significant relative to the placebo. The exercise regime, comprehensively described in a review article by Brox and others (Bøhmer et al, 1998), initially uses sling suspension to neutralise gravity. This allows relaxed, repetitive movements (shoulder rotation first, then elevation through flexion and finally through abduction), building up to a total of an hour each day. The aim is to restore full, painless, active movement; and special attention is paid to retraining normal initiation of flexion and abduction to avoid migration of the humeral head. To these ends, efforts are made to re-activate supraspinatus. Reciprocal inhibition of antagonists may be used to improve the quality of movement, and the humeral head is passively stabilised / centralised as necessary. When the range of painless active movement is improving, and normal scapulohumeral relationships restored, low resistance is gradually added (such that three sets of 50 repetitions are achievable), first by altering the point of suspension, then by using elastic resistance band. Progression is to pulley resistance in sitting, then standing, and to push ups against a wall. Over the regime's three- to six-month duration, Bøhmer et al (1998) recommend

diminishing physiotherapist supervision in favour of increasing performance of the exercises at home. But the programme is labour intensive, and its feasibility would clearly depend on equipment availability and the suitability of both the patient and the home environment, particularly from a safety perspective.

Exercise has also been shown to significantly improve recovery, function, and range of abduction at one month, compared to controls, in a mixed shoulder pain group in which 67% of the diagnoses were of impingement (Ginn et al 1997). Active interventions in this study were "stretching exercises for muscles found to be short, strengthening exercises for muscles found to be weak, and motor retraining aimed at restoring scapulohumeral rhythm during the performance of upper limb tasks". Within this framework, the frequency and details of interventions were at individual physiotherapists' discretion.

No original research appears to have evaluated closed kinetic chain activities such as rhythmic stabilisation, though these would appear to have a logical place in the restoration of scapulothoracic and scapulohumeral function, and are recommended in the descriptive literature (Hess, 2000).

Systematic reviewers have interpreted the primary RCT evidence differently. Albright et al (2001) excluded Ginn et al (1997) from their analysis on grounds of "non-validated outcomes", leading them to a conclusion of overall "insufficient evidence" as to the efficacy of exercises. More pragmatically, perhaps, Green et al (2003) acknowledge methodological flaws in the primary literature but consider that, jointly, these RCTs constitute affirmative, if weak, evidence. With regard to those studies which predate their own review, this opinion is shared by van der Heijden et al (1997).

Two RCTs (Bang and Deyle, 2000; Conroy and Hayes, 1998) show that the pain of SIS is significantly reduced at 3–4 weeks by adding mobilisation to education and exercises. One of these (Bang and Deyle, 2000) demonstrated additional benefits in terms of range of motion, strength and function. In this study, exercise comprised passive stretches for the anterior and posterior shoulder capsule and musculature, and six strengthening exercises for the muscles of the shoulder girdle and rotator cuff (comprising shoulder elevation, rowing, shoulder elevation in the scapular plane, and horizontal abduction/lateral rotation, all using resistance bands; sitting push ups; and protraction against gravity in prone, forearm-supported lying). These strengthening exercises had previously been shown, in electromyographic studies, to comprise the most effective and succinct selection for optimally activating:

- Upper, middle and lower trapezius
- Levator scapulae
- The rhomboids
- Pectoralis minor
- Middle and lower serratus anterior (Moseley et al, 1992)
- The rotator cuff; pectoralis major
- The three parts of deltoid (Townsend et al, 1991).

Bang and Deyle's (2000) manual therapy group also received passive physiological or accessory mobilisation addressing any identified limitation at the upper quadrant, applied according to standard principles (Maitland, 1991), and one or two additional home exercises to reinforce these.

In Conroy and Hayes' (1998) study, all patients received active exercises three times weekly. These included pendular exercises; postural correction; physiological stretches (auto-assisted flexion, rotations and horizontal adduction) within "tolerable limits"; and muscle strengthening exercises, including sitting push ups (emphasising the correction of postural imbalance) and isometric rotations. In the experimental group, the mobilisations, which were derived from Maitland (1991), were selected from inferior glide (with or without shoulder girdle stabilisation), postero-anterior glide and antero-posterior glide, according to the direction(s) in which accessory stiffness was identified. The approach seems formulaic in comparison with that of Bang and Deyle (2000), but offers a distinct advantage in terms of reproducibility, especially in the hands of the non-specialist physiotherapist. Conroy and Hayes (1998) did not demonstrate any improvement for attributes other than pain, but this may relate to the very small sample size studied (7 patients in each of the experimental and control groups); and their work, taken in conjunction with Bang and Deyle (2000), provides some evidence that mobilisation augments the effects of exercise in SIS (Green et al, 2003).

Evidence summary

	Level
• A programme of exercises to restore range, strength, stability and scapulohumeral rhythm is beneficial.	Ia*
• Passive mobilisation of the upper quadrant augments the beneficial effects of exercise, reducing pain and increasing range, strength and function.	Ia*

*Based on weak primary evidence

Recommendation

	Grade
Restoration of range, strength, stability and scapulohumeral rhythm	
• Passive mobilisation of the upper quadrant, as necessary, and applied according to standard principles (Maitland, 1991), augments the beneficial effects of exercise and should be utilised.	A
• A programme of exercises to restore range, strength, stability and scapulohumeral rhythm benefits SIS. A suggested 'core' set of exercises, derived from the strongest available evidence is described, illustrated and graded below. They should all be painless.	A
• Scapulohumeral and scapulothoracic rhythmic stabilisation training may be introduced from an early stage, utilising closed kinetic chain work in sitting, standing, in four-point kneeling, or using an exercise ball, such that control is achieved in progressively less stable positions. During these activities, scapular instability should be scrupulously avoided (figures 7.1–7.4).	C
• Strengthening exercises may be introduced in the form of isotonic medial and lateral rotation of the shoulder, performed elbow-at-side (Morrison et al 1997). The patient gently grips a towel (or magazine) between elbow and waist during performance of the exercise, so that contraction of deltoid is discouraged. Elastic resistance band may be used to provide light resistance, and the patient builds up to three sets of ten repetitions (with ten seconds' rest after each repetition). When this is achieved, the resistance can be increased (figures 7.5–7.6).	B
• Scapular stability when performing strengthening exercises is paramount.	C
• Stretching exercises may also be introduced at an early stage. Strengthening exercises include anterior and posterior capsular stretch, as shown in figures 7.7–7.8.	B

Recommendation

	Grade
• When muscular stability is improving, and as the shoulder becomes more comfortable, progression may be made to more vigorous strengthening exercises. The set of exercises, shown in figures 7.9–7.14, has been shown electromyographically to most efficiently activate the scapular and shoulder musculature. For those exercises which do not utilise body weight, elastic resistance band provides a convenient and adjustable resistance.	B
• The exercises are also illustrated in Appendix 10, which may be copied for distribution to patients. It is recommended that the exercises are taught on a one-to-one basis, and appropriate text added to ensure the patient's full understanding. The exercises described represent a baseline, and should not be regarded as an exhaustive list. Numerous other exercises were identified in the literature and are summarised in Appendix 11.	

Figure 7.1: Stabilisation in sitting.

Sit with palms resting on surface. Gently lean sideways so the shoulder takes a little weight. Repeat to opposite side.

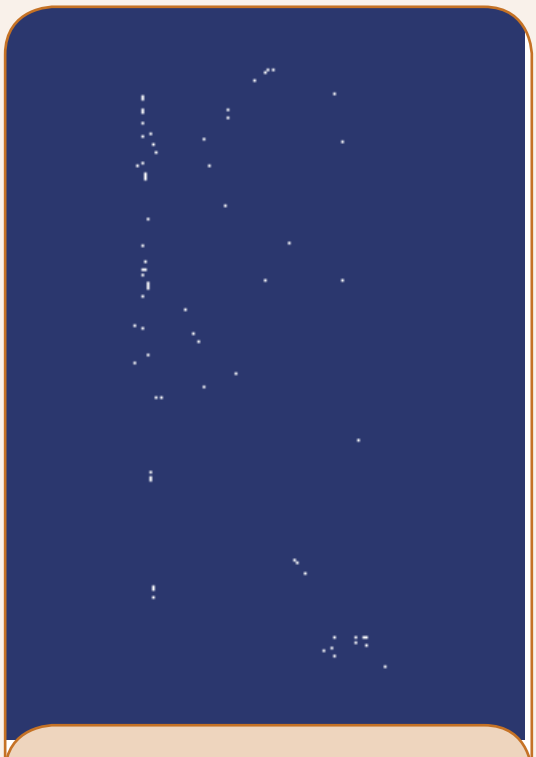

Figure 7.2: Stabilisation in standing.

Stand leaning forwards slightly, with forearms on wall so that the shoulders take a little weight. Shift your weight from side-to-side very slightly.

Figure 7.3: **Stabilisation in 4-point kneeling.**

Starting on hands & knees, gently lean forward, backward, & side-to-side

Figure 7.4: **Stabilisation with a ball. (a) 2-handed & (b) 1-handed.**

Kneeling with hands on ball, & keeping elbows straight, gently lean forward, backward & side-to-side.

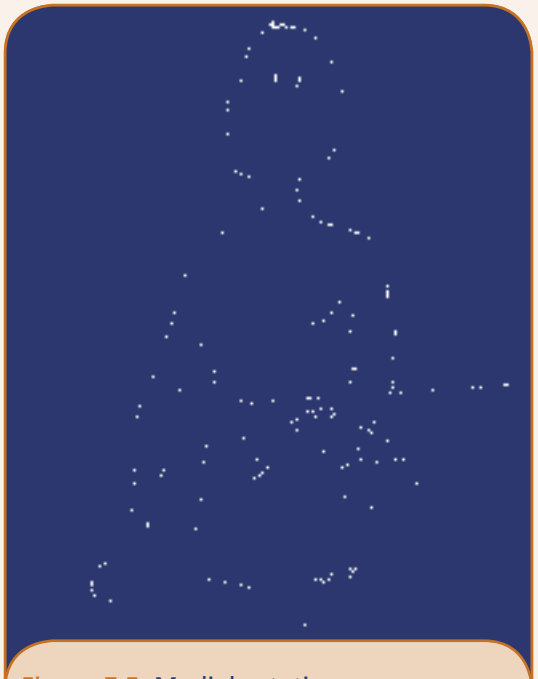

Figure 7.5: Medial rotation.

With arm bent to 90^{O}, & a towel gently held under the elbow, rotate the arm across the body using a resistance band.

Figure 7.6: Lateral rotation.

With arm bent to 90^{O}, & a towel gently held under the elbow, rotate the arm across the body using a resistance band.

Figure 7.7: Anterior capsular stretch.

Rest forearm against the side of a doorway, elbow bent. Keeping upright, gently lunge forward (into opening of doorway) until stretch is felt.

Figure 7.8: Posterior capsular stretch.

Place arm across body & gently push elbow until stretch is felt.

Figure 7.9: **Flexion.**

Starting with arm at side, pull resistance band forward & upward.

Figure 7.10: **"Rowing" (shoulder extension).**

Pull resistance band backward, bending the elbow in a rowing action.

Figure 7.11: **Scaption (in medial rotation).**

An action like drawing a sword, with the thumb pointing downwards throughout. Use resistance band.

Figure 7.12: **Horizontal abduction with lateral rotation.**

Keeping the arm horizontal, move it from front-to-back in a hitch-hiking motion, using a resistance band.

Figure 7.13: "Push ups".

With hands on chair & elbows straight, push down through shoulders to lift bottom.

Figure 7.14: "Press-ups plus".

Lie resting on forearms, letting back sag. Without lifting elbows, press down through shoulders.

Recommendations for physiotherapy interventions in SIS, including SLAP lesions and PSGI

The flow chart at Appendix 12 gives an overview of the recommendations for the management of shoulder impingement syndrome.

8.1 Reduction of subacromial inflammation and pain management

Recommendation	Grade
8.1.1 Rest	
Initially, relative rest should be recommended: overhead or other aggravating activities should be avoided in particular.	B
Absolute rest should be avoided.	C
8.1.2 Non- steroidal anti-inflammatory drugs (NSAIDs)	
The benefits of a short (7–21 day) course of NSAIDs are likely to outweigh the risks. If such medication has not been prescribed, this option should be discussed with the appropriate medical practitioner.	A
8.1.3 Cold therapy	
Cold packs may be used to reduce the pain and inflammation of SIS, and to settle irritation post-exercise. Applications vary from a maximum of 30 minutes, which may be required to achieve satisfactory deep cooling results in the obese, to a minimum of 10 minutes in the very thin (in whom longer applications increase the risk of tissue damage).	C
Cold packs should not be applied prior to exercise.	B
8.1.4 Heat	
Due to insufficient evidence, no recommendation can be made.	None
8.1.5 Pulsed Electromagnetic Fields (PEMF)	
PEMF (applied for 30 minutes on 6 consecutive days) is beneficial in the treatment of calcific tendinitis, both short- and medium-term. Though it is associated with treatment soreness, this is only transitory.	A
8.1.6 Ultrasound	
In calcific tendinitis, high intensity (2.2 W/cm^2), continuous ultrasound, applied daily for three weeks, then on alternate days for three weeks, gives short- and medium-term benefit.	A
Except in calcific tendinitis, ultrasound is not recommended for SIS.	A
8.1.7 Laser and Transcutaneous Electrical Nerve Stimulation (TENS)	
Due to insufficient evidence, no recommendation can be made.	None

8.1.8 Deep transverse friction massage (DTFM)

Due to insufficient evidence, no recommendation can be made.	None

8.1.9 Steroid injection

Steroid injections benefit SIS in the short term.	A
In view of the associated risks, it is suggested that steroid injections be used only as needed to facilitate rehabilitation. It is also suggested that normally, unless severe pain is present, a several-week trial of more conservative therapy should precede their use.	C
Resistive exercise should be withheld for 2 weeks following injection.	B
The same subacromial space should not be injected on more than 3 occasions.	C

8.2 Improvement of posture

Recommendation

An attempt to correct forward-head posture is appropriate, in view of its association with shoulder pain.	B

8.3 Restoration of range, strength, stability and scapulohumeral rhythm

Recommendation

• Passive mobilisation of the upper quadrant, as necessary, and applied according to standard principles (Maitland, 1991), augments the beneficial effects of exercise and should be utilised.	A
• A programme of exercises to restore range, strength, stability and scapulohumeral rhythm benefits SIS. A suggested 'core' set of exercises, derived from the strongest available evidence is described, illustrated and graded below. They should all be painless.	A
• Scapulohumeral and scapulothoracic rhythmic stabilisation training may be introduced from an early stage, utilising closed kinetic chain work in sitting, standing, in four-point kneeling, or using an exercise ball, such that control is achieved in progressively less stable positions. During these activities, scapular instability should be scrupulously avoided (figures 7.1–7.4).	C
• Strengthening exercises may be introduced in the form of isotonic medial and lateral rotation of the shoulder, performed elbow-at-side (Morrison et al 1997). The patient gently grips a towel (or magazine) between elbow and waist during performance of the exercise, so that contraction of deltoid is discouraged. Elastic resistance band may be used to provide light resistance, and the patient builds up to three sets of ten repetitions (with ten seconds' rest after each repetition). When this is achieved, the resistance can be increased (figures 7.5–7.6).	B
• Scapular stability when performing strengthening exercises is paramount.	C
• Stretching exercises may also be introduced at an early stage. Strengthening exercises include anterior and posterior capsular stretch, as shown in figures 7.7–7.8.	B

Recommendation	Grade
• When muscular stability is improving, and as the shoulder becomes more comfortable, progression may be made to more vigorous strengthening exercises. The set of exercises, shown in figures 7.9–7.14, has been shown electromyographically to most efficiently activate the scapular and shoulder musculature. For those exercises which do not utilise body weight, elastic resistance band provides a convenient and adjustable resistance.	B
• The exercises are also illustrated in Appendix 10, which may be copied for distribution to patients. It is recommended that the exercises are taught on a one-to-one basis, and appropriate text added to ensure the patient's full understanding. The exercises described represent a baseline, and should not be regarded as an exhaustive list. Numerous other exercises were identified in the literature and are summarised in Appendix 11.	

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9

When to refer for an orthopaedic opinion

Judging from large retrospective studies, a high proportion of patients with SIS can be expected to respond to conservative measures. Morrison (1997) has reported satisfactory-excellent outcomes in 413 (67%) of his series of 636 shoulders with SIS following a 6-week rehabilitation programme, and of 123 who subsequently relapsed, 74 responded to a re-instituted programme. Parker and Seitz (1997) report a 74% positive response to a 6-month rehabilitation programme in their review of 50 consecutive patients with 'impingement/instability overlap syndrome'. Only 4 relapsed, and all responded to a re-instituted programme.

Clearly, then, conservative measures should be given an adequate opportunity to succeed before surgery is contemplated: most authorities recommend up to 6 months (Parker and Seitz, 1997, Cavallo and Speer, 1998, Fongemie et al, 1998, American Academy of Orthopaedic Surgeons, 2002) or 3 months if rehabilitation has been continuous (American Academy of Orthopaedic Surgeons, 2002).

Preliminary conservative care is redundant in massive full-thickness cuff tears, however. The patient, probably middle-aged or elderly, is unable to actively elevate and may have markedly weak abduction as well as muscle atrophy (American Academy of Orthopaedic Surgeons, 2002).

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Appendix 1

Guideline Development Group (GDG)

Janis Cummins, who led the GDG from the outset, is a specialist musculoskeletal physiotherapist who has practiced in the USA as well as the UK. Janis has been employed by Portsmouth City Teaching Primary Care Trust for the last 10 years, and is now service manager of the physiotherapy out patient department at St Mary's Hospital, and for physiotherapy services in the Portsmouth City Teaching PCT. She continues to work as a specialist in this field.

Claire Jeffries has an extensive background in musculoskeletal physiotherapy, and has been employed by Portsmouth City Teaching Primary Care Trust for 8 years. A specialist in rheumatology and hydrotherapy, she is based at the Queen Alexandra Hospital, Portsmouth.

Nigel Hanchard is a musculoskeletal physiotherapist and teacher at both pre- and post qualifying levels, and formerly led the MSc in Allied Health Professional Studies (with Licence to Practise Physiotherapy) at the University of Teesside. Currently a Department of Health research fellow, he is based at the Teesside Centre for Rehabilitation Sciences (University of Teesside), where he is working in the area of shoulder diagnosis. He has received a Robert Williams award for previous research in this area.

Appendix 2

Advisers to the Guideline Development Group

Sue Barnard	Lecturer in Physiotherapy, Department of Health & Social Care, Southampton University (at the time of the guideline development process)
Gavin Harper	Consultant Orthopaedic Surgeon and shoulder specialist, Queen Alexandra Hospital, Portsmouth
Christine Hayward	Professional Advisor to Physiotherapy Services, Portsmouth & South East Hampshire Health Economy
Judy Mead	Head of Research and Clinical Effectiveness, The Chartered Society of Physiotherapy
Ceri Sedgley	Professional Adviser, The Chartered Society of Physiotherapy

Appendix 3

Local peer review

The first draft of the guideline document was sent out for local peer review. The reviewers were asked to consider:

- The overall development of the guidelines
- The validity of the recommendations
- The clinical relevance of the guidelines and the recommendations
- The format, layout and presentation of the guideline document

This group consisted of superintendents and team leaders in the musculoskeletal physiotherapy services of the three Primary Care Trusts (PCTs) in the Portsmouth area. In addition, the document was circulated to musculoskeletal out patient teams in the district where student, junior and senior physiotherapists were asked to comment on the points above. Members of the local peer review group were:

Nik Carter	Superintendent Physiotherapist, Queen Alexandra Hospital, Portsmouth City Teaching PCT
Martin Cowdry	Superintendent Physiotherapist, Fareham & Gosport PCT
Jill Delaney	Former Superintendent Physiotherapist, East Hampshire PCT
Gavin Harper	Consultant Orthopaedic Surgeon and shoulder specialist Queen Alexandra Hospital, Portsmouth Hospitals NHS Trust
Richard Hull	Consultant Rheumatologist, Queen Alexandra Hospital, Portsmouth Hospitals NHS Trust
John Hughes	General Practitioner, Havant Health Centre, East Hampshire PCT
Charles Lewis	General Practitioner, Fratton Road Surgery, and Chairman, Portsmouth City PCT
David Young	General Practitioner, Fareham & Gosport PCT

Appendix 4

National peer review

The first draft of the guideline document was distributed to special interest groups, leading academics and clinicians with a specific interest in this area, who had previously agreed to critically appraise it in relation to the following points:

- The overall development of the guidelines
- The validity of the recommendations
- The clinical relevance of the guidelines and the recommendations
- The format, layout and presentation of the guideline document

Members of the national peer review group were:

Pat Dunleavy	Private Practitioner and physiotherapist, British olympic swimming team
Paula Fitzpatrick	Senior Physiotherapist & Clinical Governance Co-ordinator North Bristol NHS Trust
Jeremy Lewis	Superintendent Physiotherapist, Chelsea & Westminster Hospital, London
Caroline Metcalfe	Research & Development Physiotherapist, Institute of Rehabilitation, Royal Hull Hospital
Bill Orr	Superintendent Physiotherapist, Hull & East Yorkshire Hospitals, North Bristol NHS Trust
Tony Wilson	Private Practitioner, Chichester, West Sussex

Appendix 5

Reviewers comments and GDG responses

As a result of reviewers feedback during local and national peer review, a number of alterations were made to the guidelines. The following are the main comments and actions that were taken;

1.	**Comment**	Include more detail for the guideline literature search strategies.
	Action taken	The span of years for which the literature was searched was clarified; key words and terms used were clarified.
		Examples of search strategies were included in the appendices.
2.	**Comment**	Display more concise and easily accessible details of literature used in the treatment section of the guidelines. (Appendix 9)
	Action taken	Tables formulated displaying details of the literature used within the guidelines.
3.	**Comment**	Need for clearer presentation of information in the treatment chapter of the guidelines.
	Action taken	Revision of information into sections specific to treatment recommendations i.e. cold therapy, heat therapy etc.
		Use of evidence statements to highlight important points from the text.
		Graded recommendation sections at the end of the diagnosis, assessment and treatment sections.
		Use of bold and text features to highlight the evidence and recommendation summaries.
4.	**Comment**	Clearer presentation required for the exercise recommendations, specifically in the strengthening section of the treatment chapter.
	Action taken	See Appendix 11:
		Exercises placed in tabular format, and in specific muscle groups.
		Any instructions on performing the exercises stated.
		Authors of the relevant articles stated next to each exercise.

Appendix 6

Consultation with service users: Results

The GDG has endeavoured to obtain patient/user involvement in this project by asking for feedback on the exercise sheets in Appendix 10. The exercise diagrams were given to a group of patients attending a hydrotherapy exercise group. The patients did not suffer specifically with shoulder impingement.

The group were taught the exercises by a Senior II physiotherapist, who was not part of the GDG, and then given the diagrams as an aide memoire for performing them at home. The patients/users were asked to perform the exercises within the limits of pain, once or twice a day, with a suggested number of repetitions being 3 sets of 10, with a 10 second rest after each set (see 8.3)

The patients/users were asked to consider the following points:

- Were the diagrams clear and useful as an aid to memory following the verbal explanation given to you by the physiotherapist?
- Were the recommended numbers of repetitions realistic?

Feedback

12 patients/users gave written feedback two weeks later and the following comments were made:

- 7 patients felt the diagrams needed arrows to indicate the direction of movement or a second picture to indicate more clearly how it should be performed.
- 5 patients were happy with the exercises depicted
- All 12 patients /users felt the exercise repetitions were realistic and achievable.

The physiotherapist who taught the group gave the following feedback:

- Initially the patients misinterpreted some of the exercises on the sheet, prior to the verbal explanation.
- It had been difficult to explain all the new exercises in a group situation, as individual queries may not have been dealt with adequately.

The GDG have considered this feedback and recommend that if a physiotherapist chooses to use the diagrams:

1. A full explanation of the exercises should be given, preferably on a one-to-one basis.
2. Arrows indicating direction of movement or written instructions should be added to the diagrams as necessary to enable the patient/user to perform the exercises satisfactorily.

Appendix 7

Detailed electronic search strategy

Search Strategies

Subject Search for AMED (Allied and Complemetary Medicine)

1. Shoulder Impingement Syndrome/ (13)
2. Shoulder impingement syndrome.mp (23)
3. Subacromial impingement syndrome.mp. (5)
4. ((shoulder$ or subacromial) and impingement and syndrome$).mp. [mp=abstract, heading words, title] (45)
5. 1 or 2 or 3 or 4 (45)
6. limit 5 to English language (39)
7. from 6 keep 1-39 (39)

Subject Search for Pre-MEDLINE, MEDLINE (Index Medicus)

1. Shoulder Impingement Syndrome/ (291)
2. Shoulder impingement syndrome. mp. (332)
3. Subacromial impingement syndrome.mp. (33)
4. ((shoulder$ or subacromial) and impingement and syndrome$).mp. [mp=ti, ab, rw,sh] (321)
5. 1 or 2 or3 or 4 (489)
6. limit 5 to (human and English language) [Limit not valid in Pre-MEDLINE; records were retained] (383)
7. from 6 keep 1-383 (383)

Subject Search for CINAHL (Cummulative Index to Nursing and Allied Health)

1. Shoulder impingement syndrome/ (121)
2. Shoulder impingement syndrome.mp. (126)
3. Subacromial impingement syndrome.mp. (5)
4. ((shoulder$ or subacromial) and impingement and syndrome$) .mp. [mp=title, cinahl subject heading, abstract, instrumentation] (61)
5. 1 or 2 or 3 or 4 (140)
6. limit 5 to English language (139)

Appendix 8

Article appraisal system

Critical appraisal skills

10 questions to help you make sense of a research articles about clinical effectiveness

General Comments

- Three broad issues need to be considered when appraising a research article about clinical effectiveness

A) Are the results of the article valid?

B) What are the results?

C) Will the results help me?

The following 10 questions are designed to help you think about the issues systematically.

- The first two questions are screening questions and can be answered quickly. If the answer to both is "yes", it is worth proceeding with the remaining questions.
- There is a fair degree of overlap between several of the questions.
- You are asked to record "yes", "no" or "can't tell" to most of the questions.
- A number of italicised prompts are given after each question. These are designed to remind you why the question is important.
- The 10 questions are adapted from: Guyatt GH, Sackett et al, Users'Guide to The Medical Literature, II How to use an article about therapy or prevention. JAMA 1993; 270 (21): 2598-2061 and JAMA 1994; 271 (10: 59-63).

A) Are the results of the article valid?

Screening Questions

1. Did the article address a clearly focused issue?

   Hint An issue can be focused in terms of
   - the population studied
   - the intervention given
   - the outcomes considered

☐ Yes
☐ Can't tell
☐ No

2. Was the study designed in a way which allowed it to address the issue?

   Hint A well designed study should
   - include a control group
   - recruit control and intervention groups from the same population
   - allocate subjects to groups randomly

☐ Yes
☐ Can't tell
☐ No

Detailed Questions

3. Was patient selection carried out appropriately?

   Hint Check to see whether:
   - the source of patients was reported
   - representative patients were recruited concurrently to both groups
   - inclusion and exclusion criteria were defined

☐ Yes
☐ Can't tell
☐ No

4. Was the study designed appropriately?

   Hint Check to see whether:
   - allocation was truly random "concealed"
   - the new treatment was compared with an appropriate control treatment
   - researchers and subjects were "blinded" to the treatment allocation

☐ Yes
☐ Can't tell
☐ No

5. Was the study conducted and analysed appropriately?

   Hint Check to see whether
   - the rate of refusal was stated and was acceptably low
   - a high proportion of patients completed their treatment regimes
   - all patients were properly accounted for
   - data were analysed on the basis of the "intention to treat"
   - analyses took account of the baseline differences in prognostic factors between groups

☐ Yes
☐ Can't tell
☐ No

B) What are the results?

6. What are the results of the study?

   Hint Consider
   - the size of the treatment effect
   - the units that the results are expressed in
   - whether the size of treatment effect is likely to be clinically important

☐ Yes
☐ Can't tell
☐ No

7. How precise are the results?

   Hint Consider
   - the largest and smallest treatment effects which are consistent with the observed result
   - whether the precision was good enough to exclude a chance explanation for the result

☐ Yes
☐ Can't tell
☐ No

Will the results help me

8. Can the results be applied to my patients?

   Have alternative explanations for the results been explored and discounted?

   Do you think that the patients recruited to the study were similar enough to your population?

☐ Yes
☐ Can't tell
☐ No

9. Were all clinically important outcomes considered?

   Hint Consider the importance of
   - objective clinical measures
   - subjective patient-orientated measures (e.g., quality of life)
   - side effects

☐ Yes
☐ Can't tell
☐ No

10. Are the benefits worth the harms and costs?

    This is unlikely to be addressed by the article. But what do you think?

☐ Yes
☐ Can't tell
☐ No

Appendix 9

Table of systematic reviews and critical appraisal of the primary literature.

Study	Type	Setting	Sample	Intervention
Albright J et al, 2001	Systematic review	Clinical	11 RCTs on the efficacy of physiotherapy interventions for shoulder pain.	
Bang and Deyle, 2000	RCT	Clinical	52 patients (30 male) with SIS. Mean age of the treatment group (group 1) was 42 (SD 10.1, range 27-65); of the control group (group 2) was 45 (8.4, 24–60). Duration of symptoms was comparable: 5.6 years (SD 3.7) in group 1; 4.4 (2.8) in group 2.	Group 1 & 2 received supervised exercises for mobilising & strengthening over 6 sessions. Group 1 received passive mobilisations in addition.
Becker H et al, 1979	Descriptive, retrospective review.	Clinical	61 unselected patients with finger flexor tendon lacerations. 50 were followed up for an average of 2 months.	Surgical repair with gentle active movements from the first post-operative day.
Brosseau L et al, 2003	Systematic review	Clinical	2 RCTs on the efficacy of DTF for tendinitis.	

Outcome measures	Results	Critical appraisal checklist for clinical effectiveness studies, where applicable (See foot of table, p 87 for key)										Included in a systematic review?
		1	2	3	4	5	6	7	8	9	10	
(1) Isometric strength using an electronic dynamometer. (2) Pain on active abduction, isometric 'break' testing functional activities. (3) A functional questionnaire. Assessors were 'blind' as to patient groups.	Strength improved significantly in group 1 but not group 2. Both groups' pain & function improved significantly; but group 1's significantly more so.	Y	Y	Y	N	N	Y	Y	Y	Y	Y	Green, 2003
Range of motion. Incidence of tendon rupture.	"The pattern of recovery [differed] from that seen in patients treated by conventional methods … most patients had good range of motion at 1 week and were able to touch their palms at 2 to 3 weeks". The incidence of rupture was 10%. The author attributed this to non-selection of the patients, some of whom would not comply with instructions to mobilise gently.	Y	N						?	?	?	

Study	Type	Setting	Sample	Intervention
Bøhmer AS et al, 1998	Descriptive	Clinical	See Brox 1999	See Brox 1999
Brox JI et al, 1993	RCT	Clinical	See Brox 1999	See Brox 1999
Brox JI et al, 1999	RCT	Clinical	125 patients with SIS > 3 months (stage II), resistant to NSAIDs & physiotherapy.	Group 1 undertook low-resistance, high-repetition exercises for 1 hour daily, initially in sling suspension. Emphasis was placed on establishing normal movement patterns. Unrestricted activity was typically allowed after 4–6 weeks, but the programme continued for 3–6 months. A physiotherapist supervised the exercises twice a week in the early stages, but this was gradually reduced. Group 2 underwent arthroscopic surgery. Group 3 received placebo (detuned laser) twice weekly for 6 weeks.
Buchbinder R et al, 2003	Systematic review	Clinical	26 RCTs on the efficacy of corticosteroid injections for shoulder pain.	
Conroy DE and Hayes, 1998	RCT	Clinical	14 patients (8 male) with SIS. Mean age of the treatment group (group 1) was 55 years (SD 10.2); the control group (group 2) 50.7 (16.5). Other variables were comparable across the group.	Treatments were given 3 times weekly for 3 weeks. Both groups received hot packs and exercises to mobilise and strengthen, physiological stretches, soft tissue mobilisation, and advice. Group 1 received accessory shoulder joint mobilisations, according to standard Maitland principles, in addition.

Outcome measures	Results	Critical appraisal checklist for clinical effectiveness studies, where applicable (See foot of table, p 87 for key)										Included in a systematic review?
		1	2	3	4	5	6	7	8	9	10	
See Brox 1999	See Brox 1999	See Brox 1999										See Brox, 1999
See Brox 1999	See Brox 1999	See Brox 1999										Green, 2003, van der Heijden, 1997.
Neer shoulder score, which includes measures of pain over the previous week; clinical tests of strength, reaching & stability; active range of motion; and radiological evaluation. Possible scores range from 0–100. The criterion for success was a score >80. Evaluation at 3 & 6 months and follow up at 2 years.	The success rate was higher for groups 1 and 2 than group 3 at 6 months ($p<0.001$) and 2 years ($p<0.01$). Groups 1 & 2 did not significantly differ from one another in terms of outcome.	Y	Y	Y	N	Y	Y	Y	Y	N	?	Green, 2003.
(1) Maximum pain intensity in preceding 24 hours (VAS). (2) Pain on impingement testing (VAS). (3) Active range of motion. (4) Ability to perform a standardised set of functional activities. Assessors were 'blind' as to patient groups.	Group 1 had a significant reduction in 24 hour pain intensity ($p=0.008$) and pain on impingement testing ($p=0.32$) v. group 2. Both groups' motion and function improved.	Y	Y	Y	N	N	Y	N	Y	N	Y	Green, 2003.

Study	Type	Setting	Sample	Intervention
Davidson CJ et al, 1997	Controlled trial	Laboratory	20 male Sprague-Dawley rats.	Animals were assigned to 4 groups: Group 1 underwent no intervention. Groups 2 & 3 had achilles tendinosis induced by collagenase injection. Groups 3 & 4 received deep longitudinal massage, by means of an aluminium instrument, to the lesion for 3 minutes on each of days 21, 25, 29 & 33.
De Bruijn R, 1984	Descriptive	Clinical	13 patients with various soft tissue lesions	Deep transverse friction
Enwemeka CS et al, 1988	Experimental	Laboratory	30 Wistar rats.	All animals underwent unilateral achilles tendon transection & suturing, & immobilisation in plaster cast. In group1 the splints were removed after 5 days; in group 2 the splints were removed from days 2–5 & then replaced; in group 3 (the controls) splints remained in situ.

Outcome measures	Results	Critical appraisal checklist for clinical effectiveness studies, where applicable (See foot of table, p 87 for key)										Included in a systematic review?
		1	2	3	4	5	6	7	8	9	10	
All animals underwent running gait analysis (stride length & frequency; hip, knee & ankle angular displacement) on a fixed-speed treadmill. This was conducted pre-injection and on the days preceding massage days. The animals were sacrificed 10 days after the last massage treatment, & the tendons excised for microscopy.	Only group 3 significantly improved its running performance after injury, regaining original gait patterns by the end of the study. Fibroblastic proliferation was seen in groups 2 & 3, with the largest significant increment in the latter ($p<0.05$ v. groups 1, 2 & 4 on post hoc testing). Fibroblastic activation was observed in groups 2, 3 & 4. Increments in fibronectin were also observed in groups 2, 3 & 4, suggesting that massage per se stimulates fibroblastic activation and fibronectin synthesis. Group 3 did not demonstrate benefits in collagen disposition over group 2.	Not a clinical effectiveness study										
Patient reported analgesic effect	Onset of analgesia in 0.4–5.1 min (mean 2.1). Duration 0.3 min–48 hrs (mean 26 hours).	Y	N						?	N	?	
Animals were sacrificed at 8 days & tendon breaking strengths evaluated.	The highest mean breaking strength was recorded for group 2 ($p<0.001$ v. each of groups 1 & 3). Tendon-end separations & re-ruptures were observed in groups 1 & 3, but not in group 2.	Not a clinical effectiveness study										

Study	Type	Setting	Sample	Intervention
Eustace JA et al, 1997	Descriptive.	Clinical	37 patients with shoulder symptoms of at least 3 months' duration.	Intra-articular injection of triamcinilone & radiographic contrast material using standardised technique.
Ginn KA et al, 1997	RCT	Clinical	71 patients (41 male) with unilateral shoulder pain. Pain attributable to SIS in 67%. Median age of treatment group (group 1) 56.4 (34-85); control group (group 2) 62.7 (20-80). All other variables closely matched.	Group 2 received no treatment. In group 1, specific treatment was at physiotherapists' discretion, but was directed at stretching and/or strengthening muscles as deemed appropriate, & retraining scapulohumeral rhythm.
Green S et al, 2003	Systematic review	Clinical	26 trials on the efficacy of physiotherapy interventions for shoulder pain.	
Greenfield B et al, 1995	Descriptive.	Clinical	30 healthy subjects & 30 patients with shoulder 'overuse' injuries.	

Outcome measures	Results	Critical appraisal checklist for clinical effectiveness studies, where applicable (See foot of table, p 87 for key)										Included in a systematic review?
		1	2	3	4	5	6	7	8	9	10	
Radiographs were taken immediately post-injection, & symptoms (VAS) & range of movement were evaluated pre-injection & 2 weeks post-injection.	4/14 (29%) of attempted subacromial injections were judged to be accurately placed, & 10/24 (42%) of attempted glenohumeral injections. There were significant differences in relation to outcome between the accurately placed & inaccurately placed groups.	Y	N						?	N		Green, 2003, Van der Heijden, 1997
(1) Range of motion. (2) Isometric strength. (3) VAS following standardised reaching task. (4) Self rated disability score. Assessors were blind as to patient groups.	Group 1 improved significantly v. group 2 in terms of range of abduction (p=0.006) and flexion (p=0.04), and self rated disability score (p=0.03).	Y	Y	Y	N	N	Y	Y	?	Y	Y	
Scapular protraction & rotation, forward head position, mid-thoracic curvature & passive scaption were evaluated using standardised & validated techniques.	Forward head posture was significantly greater in the patient group (p<0.001).	Not a clinical effectiveness study										

Study	Type	Setting	Sample	Intervention
Hart DP and Dahners LE, 1987	Experimental	Laboratory	The medial collateral ligament of the knee was transacted in 75 male Sprague-Dawley rats. In 37 animals (group 1), secondary stabilising ligaments were left intact. In 38 animals (group 2) the secondary stabilising ligaments were transacted in addition to the collateral ligament.	Each group was divided into 'surgical repair' or 'no repair' subgroups, and these were further divided into 'immobilisation' or 'free mobilisation' subgroups.
Hollingworth GR et al, 1983	RCT	Clinical	77 patients with mixed diagnosis shoulder pain.	Injection of 2 ml methylprednisolone acetate (40 mg/ml) mixed with 1% lidocaine into: Group 1: tender point. Group 2: anatomical structure determined by Cyriax's selective tissue tension examination. Cross-over injection given if pain not considerably reduced after 1 week.
Itzkovitch D et al, 1996	RCT	Clinical	80 outpatients with mean age 58 years (SD 12 years, range 50-97) with SIS ± movement restriction, & pain < 4 at rest or on active movement.	1 weekly periarticular injection of tenoxicam 20 mg or placebo for 1–4 weeks.

Outcome measures	Results	Critical appraisal checklist for clinical effectiveness studies, where applicable (See foot of table, p 87 for key)										Included in a systematic review?
		1	2	3	4	5	6	7	8	9	10	
The animals were sacrificed at 14 days and the ligaments evaluated for laxity and strength.	If the secondary stabilisers were intact, the ligaments were less lax in the 'free mobilisation' than in the 'immobilisation' subgroups. If the secondary stabilisers were not intact, this situation reversed. All ligaments were weaker than controls, but the 'free mobilisation' subgroups were all significantly stronger than their 'immobilisation' counterparts ($p<0.05$).	Not a clinical effectiveness study										
Success defined as reduction of pain from severe to mild or nil, with corresponding clearing of signs on objective examination.	Significant benefit in anatomical injection group over tender point injection (60% v. 20% success, $p<0.001$)	Y	Y	Y	Y	Y	Y	Y	Y	N	N	Buchbinder, 2003
Clinical index, pain during active movement and at rest (VAS), active range of motion, pain on pressure, patient's and clinician's global impression.	All outcome measures improved significantly more in the tenoxicam treated group v. the controls. There were no significant differences in safety assessments between groups.	Y	Y	Y	?	Y	Y	?	Y	N	Y	

Study	Type	Setting	Sample	Intervention
Morrison DS et al, 1997	Descriptive, retrospective review.	Clinical	636 shoulders in 616 patients (386 male) diagnosed with SIS. Mean age 42 years (15–81).	3 week course of NSAIDs. When pain allowed, soft tissue stretching until full range restored. Then a 6 week programme of strengthening exercises emphasising shoulder medial and lateral rotation. When the shoulder was painless and fully functional, a general strengthening programme was instituted in patients with high functional demands.
Moseley JB jr et al, 1992	Descriptive	Clinical/Laboratory	9 normal male volunteers.	16 scapular muscle strengthening exercises were evaluated.
Murrell GAC et al, 1998	Experimental	Laboratory	10 male Sprague-Dawley rats randomised to each of an experimental group (group 1) and a control group (group 2).	In both groups the Achilles tendon was surgically transected. Group 1 underwent 15 minutes' swimming each day.

Outcome measures	Results	Critical appraisal checklist for clinical effectiveness studies, where applicable (See foot of table, p 87 for key)										Included in a systematic review?
		1	2	3	4	5	6	7	8	9	10	
Clinician-administered *Shoulder-Rating Scale of the University of California at Los Angeles,* covering the domains of: pain, function, range of movement, strength, and patient satisfaction.	Of the total, 67% had a satisfactory, good or excellent result; 28% derived no benefit and proceeded to surgery; 5% derived no benefit but declined surgery. Of those with a satisfactory, good or excellent result, 30% relapsed (18% again responded to the intervention: 12% did not). Age < 20 years), acromial type I (as against types II or III), and acuteness (v. 'non-acuteness' or chronicity) were all associated with more successful outcomes.	Y	N						Y	N	Y	
Dynamic, fine-wire intramuscular electromyography.	A core set of 4 exercises, namely: (1) scaption, (2) rowing, (3) 'push up plus' (i.e. plus protraction), & (4) 'press up' (in sitting position, lifting bottom from chair), was found to efficiently activate all muscles.	Not a clinical effectiveness study										
Functional performance was determined by measuring hindpaw prints of walking rats pre-operatively & on alternate post-operative days. Rats were sacrificed on day 15 & the tendons evaluated morphologically & mechanically.	Supplemental exercise had no effect on functional or mechanical recovery.	Not a clinical effectiveness study										

Study	Type	Setting	Sample	Intervention
Parker RD et al, 1997	Descriptive, retrospective review	Clinical	50 consecutive patients (18 male) with "impingement/ instability overlap syndrome". Mean age was 26 years (range 13–38 years). All had a positive impingement sign, a positive apprehension test (which remained so after the impingement injection test), and symptoms of impingement and instability.	Rest, NSAIDs and heat for 7–10 days, or until significant pain abated. When pain allowed, exercises were commenced below 90° of elevation, initially isometrics, but progressing over 3–6 weeks through isotonics to isokinetics, and from strength to endurance. A work- or sport-specific programme was then commenced and continued for at least 6 months. This was followed by a maintenance programme.
Partington PF and Broome GH, 1998	Descriptive	Cadaveric	24 cadaveric shoulders.	Dye was attemptedly injected into the subacromial bursa.
Speed C and Hazleman B, 2003	Systematic review	Clinical	Evidence from systematic reviews and RCTs on interventions for shoulder pain.	
Towheed TE et al, 2003	Systematic review	Clinical	6 RCTs (involving1689 patients) on the efficacy of NSAIDs for osteoarthritis.	
Townsend H et al, 1991	Descriptive	Laboratory	15 normal male volunteers.	17 shoulder strengthening exercises (derived from a shoulder rehabilitation programme used by professional baseball clubs) were evaluated.

Outcome measures	Results	Critical appraisal checklist for clinical effectiveness studies, where applicable (See foot of table, p 87 for key)										Included in a systematic review?
		1	2	3	4	5	6	7	8	9	10	
Evaluation was by clinical history and examination and, initially, radiology.	Radiographs were all normal. In 75% of cases symptoms resolved, allowing resumption of previous levels of activity. The remainder required surgical intervention, having failed to benefit from 6 months of rehabilitation.	Y	N						?	?	?	
The shoulders were subsequently dissected to reveal the fate of the dye.	83% of subacromial injections were successful, but in 15 shoulders other structures were inadvertently infiltrated, including the rotator cuff in 7.	Not a clinical effectiveness study										
Dynamic, fine-wire intramuscular electromyography.	4 exercises were consistently found to be the most challenging for every muscle, namely: (1) scaption, in thumbs-down position (2) flexion (3) horizontal extension with lateral rotation (4) 'press up' (in sitting position, lifting bottom from chair)	Not a clinical effectiveness study										

Study	Type	Setting	Sample	Intervention	
Van der Heijden GJMG et al, 1997	Systematic review	Clinical			
Yamakado K, 2002	Descriptive & pre-test, post-test study.	Clinical	56 shoulders in 53 patients (19 men) mean age 74.5 years (range 49–91) with SIS of > 2 months' duration.	Attempted subacromial injection of 0.5 ml (2.5 mg betamethasone acetate), 7 ml of 1% lidocaine, & radiographic contrast material, using a lateral approach.	

Outcome measures	Results	Critical appraisal checklist for clinical effectiveness studies, where applicable (See foot of table, p 87 for key) 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10	Included in a systematic review?
Radiographs were taken immediately post-injection. Pain on both Neer & Hawkins' impingement tests was evaluated pre- & immediately post-injection, using a self-rated, 4-point score.	70% of injections were judged to have reached the subacromial bursa. 21% were seen to have entered the deltoid muscle, 4% were intra-articular & 5% subcutaneous. No significant difference in pain reduction were observed between the subacromial & deltoid injections.	Not a clinical effectiveness study	

Appendix 9: Table Key

1	Did the article address a clearly focused issue?
2	Was the study designed in a way which allowed it to address the issue?
3	Was patient selection carried out appropriately?
4	Was the study designed appropriately?
5	Was the study conducted and analysed appropriately?
6	What are the results?
7	How precise are the results?
8	Can the results be applied to my patient?
9	Were all clinically important outcomes considered?
10	Are the benefits worth the harms and costs?
Y	yes
N	no
?	unclear
shaded cells	not applicable

Appendix 10

Shoulder exercises: Home programme

Aide memoire

Your physiotherapist will tell you which of these exercises you need to do, how many times and how often, and give you detailed instructions. The exercises should never hurt.

1. Stabilising exercises

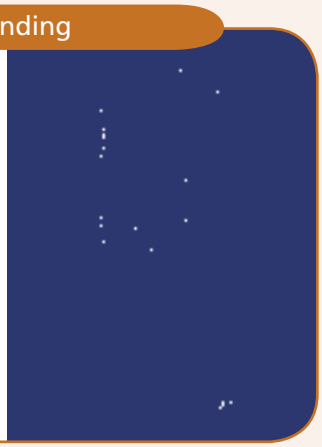
The idea is to get your shoulder used to supporting you in less & less stable positions. Keep gently moving your bodyweight to "activate" the stabilising muscles around your shoulder.

Sitting

Notes:

Standing

Notes:



Kneeling

Notes:

With a ball (2-handed)
With a ball (1-handed)

Notes:

2. a) Starter strengthening exercises
b) Stretching exercises

You'll need stretchy exercise band to do the first 2 exercises. Your physiotherapist will give this to you.

Strengthening exercise 1

Notes:

Strengthening exercise 2

Notes:

Stretching exercise 1

Notes:

Stretching exercise 2

Notes:

3. More advanced strengthening exercises

Forward Flex

Notes

Rowing

Notes:

Thumb-down lift

Notes:

Hitch-hike

Notes:

"Push up"

Notes:

Rounding shoulders

Notes:

Appendix 11

Summary of exercise protocols for shoulder impingement syndrome

The table summarises exercises described by various authors, as discussed in the main guideline document.

Medial & lateral rotators (MR & LR)

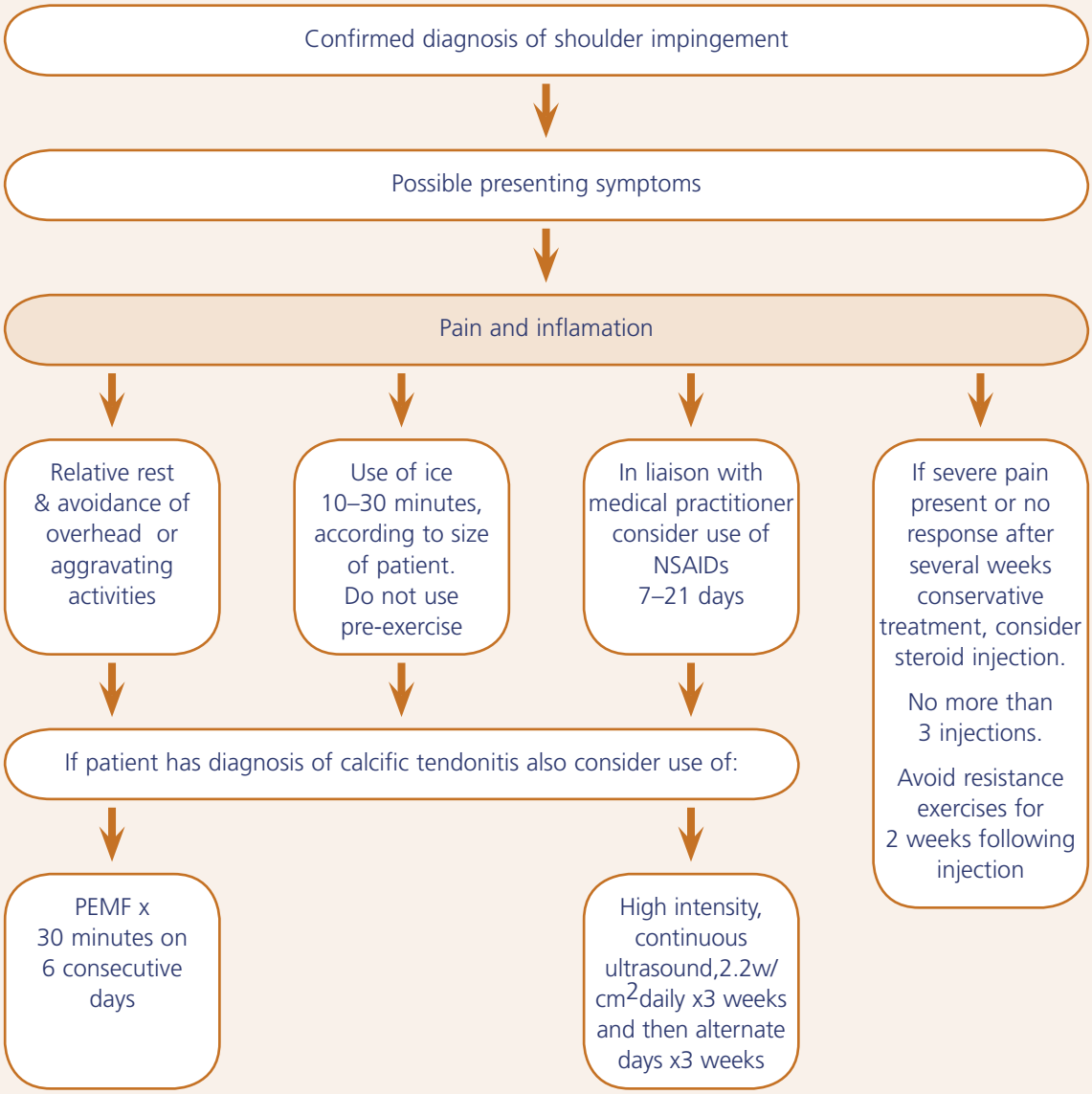
Author	Exercise description
	Isotonic exercises
Bang and Deyle, 2000	• Perform LR in horizontal extension, in standing using stretchy band • Band resistance is determined by 10 rep max • Perform 3 sets x 10 reps with 60 sec rest between sets
Brox et al, 1999	• Using sling suspension, supine or sitting, with gradual increase of abduction angle • Perform in standing with a pillow in the axilla using stretchy band
Parker and Seitz, 1997	• MR and adduction below 90^{O} elevation ("lock in" exercise) • LR & adduction below 90^{O} elevation ("balance of power" exercise) • Perform for 3–6 weeks through isotonic to isokinetic
Morrison et al,1997	• Perform with arm by side to exclude deltoid • Use stretchy band • 3 sets x 10 reps, arm held in neutral for 10 seconds after each rep • Continue for 6 weeks
Rodgers and Crosby,1996 Zuckerman et al, 1991	• Perform using free weights or stretchy band in a comfortable range.
	Supraspinatus & deltoid
Bang and Deyle, 2000	• Scaption against stretchy band resistance & elevation in standing against stretchy band resistance.
Kamkar et al, 1993	• Elevation of the externally rotated arm in the scapular plane using free weights
Morrison et al, 1997	• Only strengthen if completely pain free and a high level of function is needed
Rodgers and Crosby, 1996	• Using free weights or elastic resistance band

Scapular Stabilisation

Bang and Deyle, 2000	• Seated press up – perform to fatigue or 25 reps • Prone elbow push up plus – perform to fatigue or 25 reps • Rowing in standing against the resistance of stretchy band – 3 sets of 10 reps with 60 second rest period between sets
Brox et al, 1999	• Push up against a wall
Conroy and Hayes, 1998	• Chair press
Kamkar et al, 1993	• Wall push with emphasis on protraction of the scapula • Serratus anterior punch in supine • Seated push up • End range shoulder flexion with free weights in prone • Rowing in prone with free weights • Scapular retraction in prone using free weights, arm positioned in internal rotation & horizontal abduction
Parker and Seitz, 1997	• Specific exercises not stated in literature, but recommends strengthening trapezius, rhomboids & serratus anterior, working below 90^0 abduction
Rodgers and Crosby, 1996	• Specific exercises not stated in literature, recommend use of free weights or stretchy band, and progression to overhead movements

Appendix 12

Recommendations for the physiotherapeutic management of shoulder impingement syndrome: Flow chart




Reduced R.O.M, power and altered scapulohumeral rhythm
Altered posture
Passive mobilisations and stretching exercises
Scapulo-thoracic rhythmic stabilisation exercises
Strengthening exercises
Correction of forward head posture
All exercises should be pain free
• Closed chain stability – sitting, standing, four point kneeling, gym ball.
• Resistance – free weights, resistance band
Referral for orthopaedic opinion – If symptoms persist after 6 months conservative treatment, or 3 months if treatment has been continuous